Chapter 3

AFFECTED ENVIRONMENT / ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter offers an overview, by resource program, of the affected environment and the differing environmental effects likely to result from implementation of an alternative. The affected environment includes the existing physical, biological, and socioeconomic components that may be changed by implementation of an alternative.

An analysis of the environmental effects for both the short and long-term, particularly as they relate to the Significant Issues, provides the basis for comparing alternatives. Direct and indirect effects as well as cumulative effects are components of this comparison.

While not specifically identified in this chapter, irreversible and irretrievable commitments of resources are factors in any analysis of environmental effects. Such commitments are usually made at the project level rather than the programmatic level of a Forest Plan.

Irreversible commitments are decisions affecting non-renewable resources such as soils, minerals, and heritage remains. These commitments are considered irreversible because the resource has been destroyed or removed or has deteriorated to the point that renewal can occur only over a very extended period or at great expense.

Irretrievable commitments represent resource uses or opportunities that are forgone or cannot be realized during the planning period. While these decisions are reversible, the opportunities forgone are irretrievable. An example is the application of Standards that do not allow camping where camping might have been allowed. While the decision not to allow camping can be reversed, the opportunities to camp during the period when it was not permitted are irretrievable.

Physical Elements

AIR QUALITY

Affected Environment

In addition to protecting the air, land, and water resources under their jurisdiction from the impacts of air pollution produced outside of federal lands (Clean Air Act 1990), statutes and regulations also require federal land managers to protect air, land, and water from the effects of air pollutants originating from within federal lands (Clean Air Act 1990, Organic Act 1977, Wilderness Act 1997). Activities within the Daniel Boone National Forest such as prescribed burning, road construction/maintenance, mineral development, recreational use, and timber harvesting all have an impact on the air quality of National Forest System land. The Forest Service must minimize the impact of management activities on natural resources, including the Forest's contribution to general air pollution. To fulfill this responsibility, the DBNF must understand the impacts of pollution originating on National Forest System land as well as the impacts of pollution from sources outside the Forest.

The Daniel Boone National Forest is located in an area of increasing population growth and the associated demand for electricity and transportation (SAMI 2002). Lying near the industrial heart of the United States, the Forest is surrounded by a high concentration of coal-fired electrical generating facilities, the leading sources of sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions. This network of coal-fired electrical power plants includes the generally defined Ohio River valley as well as Tennessee Valley Authority (TVA) sources. In Kentucky alone there are 18 operating coal-fired power plants (EPA 1999), with several more recently permitted by the state. The Paradise coal-fired power plant, located within 150 miles of the Forest, is the largest point source of NO_x emissions and the second largest point source of SO_2 emissions in the nation. The five largest NO_x emitting point sources and five of the ten largest SO_2 sources in the nation are also located within 150 miles of the Forest; all are electric generating plants. In addition, two interstate highways intersect the Forest, adding additional NO_x and volatile organic compounds to the atmosphere.

Nitrogen oxides are an important contributor to the formation of ground-level ozone on hot sunny days (Chameides and Cowling 1995). Ozone affects the human respiratory system as well as vegetation. From 2000 through 2002, ozone concentrations at 2 out of 6 monitors located near the Forest exceeded, the new 8-hour ozone National Ambient Air Quality Standard (NAAQS) (Table 3 - 1). The 8-hour NAAQS is exceeded if the 3-year average of the 4th highest 8-hour concentrations exceed 0.085 parts per million.

Table 3 - 1. Fourth highest maximum 8-hour ozone values, in parts per million, for ozone monitoring sites located near the DBNF.

COUNTY	AIRS No.	2000	2001	2002	3-Year Average
Bell	21-013-0002	**.090**	.077	**.091**	**.086**
Boyd	21-019-0017	**.079**	**.085**	**.102**	**.088**
Carter	21-043-0500	.080	.076	.086	.080
Fayette	21-067-0012	.076	.078	.080	.078
Perry	21-193-0003	.072	.072	.083	.075
Pulaski	21-199-0003	.087	.077	.077	.081

Values in bold print exceed the NAAQS.

Air quality sampling, analysis and reporting is the result of joint effort of the Kentucky Division of Air Quality (KDAQ) and the U.S. Environmental Protection Agency. Data summaries were obtained from Kentucky's DAQ Annual Ambient Air Monitoring Data Reports for 2001.

Ozone exposures measured at these sites have been high enough to retard growth of susceptible plant species and may lower the abundance of ozone-sensitive species on the Forest (SAMI 2002). About 35 percent of nitrogen oxides affecting the Forest originates from electric generating plants (especially during hot summer days when electricity is needed to cool homes and businesses). Another 34 percent comes from highway vehicles. As current air laws, rules, and regulations are fully implemented nitrogen oxide emissions are predicted to decrease 24 percent by 2010, and 37 percent by 2040 in comparison to 1990 emissions (SAMI 2002). These reductions should lower the highest concentrations of ozone, resulting in only minimal effects from ozone on vegetation growth by the year 2040. Further reductions in nitrogen oxide are also anticipated as state and local air pollution control agencies seek ways to attain the new ozone standard in urban areas near the Forest (SAMI 2002). Continued reduction of nitrogen oxide emissions will benefit the health of Forest visitors as well as vegetation.

Sulfur dioxide and nitrogen oxide emissions are transformed in the atmosphere into sulfates and nitrates (from sulfur dioxide and nitrogen oxides), which contribute to acid deposition and regional haze. Approximately 80 percent of the sulfur dioxide emissions affecting the Forest are released from coal-fired power plants. Power plants to the west and southwest of the Forest most likely influence the acidity and sulfate concentration of rainfall on the Forest (SAMI 2002). Monitoring data from eastern Kentucky suggests that the Forest lies in an area of moderately high sulfate and nitrate deposition for the United States. This level of deposition can be detrimental to aquatic and soil resources in ecosystems not adequately buffered. Most of the Forest's soils and geology have sufficient buffering capacity and acidification is not evident. However, there are limited areas of the Forest, usually on ridges, that appear to be more sensitive to acidification (Barton et al. 2002). Aquatic ecosystems on the Forest show no signs of acidification from atmospheric deposition, again due to adequate buffering. The same pollutants that cause acid deposition also affect visibility.

Regional haze and reduced visibility is caused primarily by sulfates emitted by coal-fired power plants. The estimated natural background visibility for the eastern United States is 93+28 miles (NAPAP 1991). However, there has been a significant reduction in how far an observer can see into the distance as well as the clarity of that view. Visibility monitoring data from Mammoth Cave National Park provides the best estimate of haze conditions on the forest. The clearest days have the lowest fine particle mass (4.23 microgram per cubic meter [ug/m3]), and estimated visibility is 57 miles (using the annual average relative humidity of 84%). On the highest mass (20.67 ug/m3) days the visibility is reduced significantly to 14 miles. These days are most likely to occur from May through September (IMPROVE 2002), a time of high visitation by the public. Secondary fine particles ($PM_{2.5}$, i.e., fine particulate matter less than 2.5 microns in diameter) are primarily responsible for visibility impairment, with sulfates the most significant of these fine particles. On low mass days sulfates comprise 48 percent of the total mass, while on the highest mass days, sulfates comprise 70 percent of the total (IMPROVE 2002).

Sulfur dioxide is expected to decrease 22 percent by 2010 and at least 60 percent by the year 2040 in the Southern Appalachians (SAMI 2002). Further reductions by coal-fired power plants in North Carolina (as a result of recent state legislation) and the Tennessee Valley Authority may benefit visibility and air quality on the southern portion of the Forest.

The fine particles that cause visibility impairment also can be unhealthy for people, because high concentrations aggravate respiratory conditions such as asthma. Fine particles are closely associated with increased hospital admissions and emergency room visits for heart and lung disease, increased respiratory disease and symptoms, decreased lung function, and even premature death (EPA 1997a). Vulnerable groups at greater risk include the elderly, individuals with cardiopulmonary diseases such as asthma, and children. This makes monitoring of fine particle levels important.

Monitoring results for fine particulates include both fine primary particulate (that emitted directly from a source) and secondary particulate (resulting from the transformation of gases in the atmosphere). The U.S. Environmental Protection Agency has established NAAQS for fine particles ($PM_{2.5}$) based on three-year averages of the monitoring data. The $PM_{2.5}$ annual average standard is 15 micrograms per cubic meter (ug/m3). Table 3 - 2 lists results from monitors near the Forest from 2000 through 2002. Results indicate that the annual average $PM_{2.5}$ standard may have been exceeded at the Bell, Boyd and Fayette County monitors. The annual average is also very close to violating the standard at the Madison and Perry County monitors. The $PM_{2.5}$ short-term (24-hour) standard is 65 ug/m3 based on a 3-year average of the annual 98th percentile values. (Note that the short-term concentrations are maximum values, not the 98^{th} percentile). The 24-hour average NAAQS does not appear likely to be exceeded when the data from the closest monitoring sites to the Forest are averaged for three years.

Table 3 - 2. Annual average and 24-hour maximum fine particulate concentration (ug/m3) for monitoring sites located near the DBNF.

		2000		2001		2002	
County	AIRS No.	Annual Average	24-hour Maximum	Annual Average	24-hour Maximum	Annual Average	24-hour Maximum
Bell	21-013-0002	**18.1***	41.5	**15.1**	36.8	**14.3**	34.5
Boyd	21-019-0017	**17.2**	37.2	**15.3**	54.4	**15.5**	46.8
Carter	21-043-0500	**15.1**	29.5	12.4	47.3	12.4	39.3
Fayette	21-067-0012	**17.2**	38.6	**15.7**	48.6	**15.9**	56
Fayette	21-067-0014	**17.5**	39.5	**16.2**	49.0	**16.5**	51.9
Laurel	21-125-0004	---	---	---	---	13.0	23.5
Madison	21-151-0003	**15.9**	37.3	13.9	50.6	14.4	49.8
Perry	21-193-0003	**16.8**	34.9	14.3	36.5	13	25.4

*Values in bold print exceed the NAAQS

Air quality sampling, analysis and reporting is the result of joint effort of the Kentucky DAQ and the U.S. Environmental Protection Agency. Data summaries were obtained from Kentucky's DAQ Annual Ambient Air Monitoring Data Report for 2002, and EPA AIRS website, http://www.epa.gov/air/data/index.html. There is only one year of data available for the Laurel County monitor that was installed in 2002.

Based on the 2000-2002 ozone and fine particulate figures, the Lexington metropolitan statistical area (Fayette County monitors) could reach non-attainment for fine particulate. The Huntington metropolitan statistical area (which includes Boyd, Carter and Greenup Counties) and Bell County could reach non-attainment for fine particulate and ozone. Ultimately, the state and the EPA will make non-attainment determinations for fine particles and ozone based on a more recent set of monitoring data. Minimizing prescribed fire emissions to the greatest extent practical during days characterized by existing or predicted high ambient air pollution, therefore, becomes an even higher priority for prescribed fire managers. The $PM_{2.5}$ standard may require even more vigilance in smoke management to protect citizens on and off National Forest System lands from the effects of particulate emissions associated with prescribed fire.

Once an area is cited for non-attainment, a State Implementation Plan is developed in an attempt to bring the area back into attainment. This usually involves placing controls on various sources that contribute to the pollutant of concern. Current emission inventories do not accurately reflect emissions from prescribed burning. Since 70 percent of particulate emissions from prescribed fires are fine particles, and nitrogen oxides and volatile organic compounds are also released, state air regulators will be concerned. The Forest will need to interact closely with the KY Division of Air Quality and the Regional Haze Planning Organizations to ensure that Forest prescribed fire emissions (and perhaps other Forest activities) are accurately considered in State Implementation Plans for PM2.5 and visibility.

Air Quality -- Effects of Prescribed Fire

As an ecological process, prescribed fire is essential in creating and maintaining functional ecosystems and achieving other land use objectives. However, emissions from prescribed fire, as well as from wildland fire, affect air quality. In 1997, the Environmental Protection Agency (EPA) adopted more stringent air quality standards for ozone and $PM_{2.5}$ to protect human health (EPA 1997b). One challenge in using prescribed fire is balancing the public interest objectives of protecting human health and welfare (from air pollution) with sustaining ecological integrity. Recognizing this, the EPA developed an interim air quality policy for wildland and prescribed fires that allows fire to function, as nearly as possible, in its natural role of maintaining healthy ecosystems, but still protects public health and welfare by mitigating the impacts of emissions on air quality and visibility (EPA 1998).

To minimize the negative effects of smoke and associated pollutants on visibility and human health, smoke management plans are a required part of every prescribed fire burn plan. The smoke management plan identifies smoke dispersion characteristics that must be met in the weather forecast for the day of the burn. These characteristics include: the depth of the atmosphere available for smoke mixing (dispersion), transport wind speed and direction, and the probability of air mass stagnation during the day. The Forest also identifies smoke sensitive targets (including non-attainment areas) within the probable smoke impact area and coordinates with them to avoid or mitigate problems. Actual weather conditions and smoke behavior are monitored to make sure they meet the plan. By planning and executing prescribed fires on days that maximize smoke dispersion and avoiding smoke sensitive areas, the negative effects of smoke can be reduced.

Several alternatives propose substantial increases in the use of prescribed fire over current levels. At the same time, some counties within or near the Forest proclamation boundary could well exceed the National Ambient Air Quality Standards for $PM_{2.5}$ and be found in non-attainment (Table 3 - 2). Information sharing and other cooperation between the Forest Service, the Kentucky Division of Air Quality, and others will be essential to incorporate Forest Service emissions into the inventories needed to develop future attainment plans. The Forest will also be expected to follow Conformity Determination rules and report any prescribed fire emissions for activities planned in non-attainment areas.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

[Note: There were no cumulative effects common to all alternatives.]

Emissions from both prescribed and wildland fires are generated by incomplete combustion and include particulate matter, carbon monoxide, carbon dioxide, nitrogen oxides, and hydrocarbons (Hardy et al. 2001). The single-most important emission is fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), which limits visibility and aggravates respiratory conditions in susceptible individuals. Fine particulates ($PM_{2.5}$) make up more than 70 percent of the mass of particulate matter produced by fire. Therefore, $PM_{2.5}$ emissions were used to compare the direct effects of alternatives on air quality. Emission estimates are calculated for the maximum acres planned for treatment using our best estimates of fuel type, amount of fuel consumed, and emission rates for the types of burns planned. The results are presented in Table 3 - 3. Acres burned in any year, as well as resulting $PM_{2.5}$ emissions, will depend on weather conditions and other factors that must be considered prior to initiating a prescribed fire.

Particulate emissions from prescribed fire are only one of many sources of $PM_{2.5}$ pollution. Other sources of include power plants, various industries, and motor vehicles. For direct and indirect effects analysis, Forestwide $PM_{2.5}$ emissions were estimated for each Alternative and compared to historic prescribed-fire emissions and current primary $PM_{2.5}$ emissions from other sources. The analysis area is comprised of Kentucky counties containing National Forest System lands. The cumulative analysis also includes prescribed fire anticipated on the Big South Fork National River and Recreation Area, where approximately 300 acres per year may be burned (including lands in Kentucky and Tennessee). No other prescribed burning that is anticipated in the analysis area.

The most recent EPA emissions inventory, used to compare prescribed fire emissions to total emissions in the analysis area, estimates primary $PM_{2.5}$ emissions at 10,993 tons per year (EPA 1999). In addition to the fine particulates emitted directly into the atmosphere (primary pollutants), fine particulates can be created from gaseous pollutants that are chemically transformed into particulates in the atmosphere (secondary pollutants). Emission inventories track only primary pollutants; fine particulates from secondary pollution are not included. Because a large amount of $PM_{2.5}$ is secondary pollution, the contribution of prescribed fire emissions to total $PM_{2.5}$ will probably be less than shown in this analysis.

Predicted changes in emissions are based on a regional assessment and are not representative of any one location on the Forest. Estimated emissions would not be evenly distributed across the Forest because treatment areas vary annually. Site-specific analyses of smoke dispersion and downwind fine particulate impacts take place when sites are selected for treatment.

Table 3 - 3. Estimated particulate matter ($PM_{2.5}$) emissions, in tons, resulting from prescribed fires on the DBNF.

			Percent Change from Current Inventory			
	Annual Emissions		Emissions Due to Direct/Indirect Effects		Emissions Due to Cumulative Effects	
ALT.	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
A	761	761	6.9	6.9	7.0	7.0
B-1	143	143	1.3	1.3	1.4	1.4
C	1,159	2,458	10.5	22.4	10.7	22.5
C-1	1,159	2,458	10.5	22.4	10.7	22.5
D	1,159	2,458	10.5	22.4	10.7	22.5
E-1	143	143	1.3	1.3	1.4	1.4

Current $PM_{2.5}$ emission levels were taken from the EPA 1999 emissions inventory available at http://www.epa.gov/air/data/netdb.html

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Alternative A represents a continuation of the prescribed fire program of the 1985 Plan. Prescribed fire would be authorized on a maximum of 15,000 acres annually, producing approximately 761 tons of $PM_{2.5}$ per year. However, the largest program over the last 10 years occurred in 1997 when 12,929 acres were treated. $PM_{2.5}$ emissions that year were estimated at 539 tons. On average, the Forest has treated 5,698 acres annually with prescribed fire since 1992. Estimated $PM_{2.5}$ emissions from this program total 227 tons. The analysis of direct and indirect effects that follows for all alternatives assumes that it is appropriate to compare emissions from alternatives to the average emissions from actual prescribed fire programs over the past 10 years.

CUMULATIVE EFFECTS

Emissions from Alternative A represent approximately seven percent of primary $PM_{2.5}$ emissions in the analysis area. Additional prescribed fire activity anticipated in the analysis area would occur on the Big South Fork National River and Recreation Area, where approximately 300 acres of shrubland or forested land might be burned per year, including lands in Kentucky and Tennessee. Emissions from these burns would contribute an estimated 13 tons annually to $PM_{2.5}$ concentrations. Addition of the Big South Fork emissions to the Alternative increases the prescribed fire contribution to overall $PM_{2.5}$ about one-tenth of one percent. Other land management agencies within the proclamation boundary also plan to burn grasslands, but at a level that would contribute negligibly to emissions.

ALTERNATIVES B-1 AND E-1

DIRECT AND INDIRECT EFFECTS

Since the number of acres proposed for treatment in Alternatives B-1 and E-1 are the same, emissions would be the same. These alternatives propose prescribed fire on 2,377 acres annually, producing approximately 143 tons per year of fine particulates each year.

On average, the Forest has used prescribed fire on 5,698 acres annually since 1992, producing an estimated 227 tons of $PM_{2.5}$ emissions each year. In comparison, acres treated under Alternatives B-1 and E-1 would decrease along with emissions.

CUMULATIVE EFFECTS

Emissions from Alternative B-1 and E-1 would increase primary $PM_{2.5}$ emissions in the analysis area about one percent. Additional prescribed fire activity anticipated in the analysis area would occur on the Big South Fork National River and Recreation Area, where approximately 300 acres per year might be burned, including lands in Kentucky and Tennessee. Emissions from these burns would contribute an estimated 13 tons annually to $PM_{2.5}$ concentrations. Addition of the Big South Fork emissions to the alternatives increases the prescribed fire contribution to overall $PM_{2.5}$ about one-tenth of one percent. Other land management agencies within or near the proclamation boundary also plan to burn grasslands, but at a level that would contribute negligibly to emissions.

ALTERNATIVES C, C-1, AND D

DIRECT EFFECTS

Since the number of acres proposed for treatment in Alternatives C, C-1, and D are the same, emissions would be the same. Alternatives C, C-1, and D would incrementally increase the acres treated over the first 10 years of the planning period from 15,000 to 50,000 acres. Emissions were calculated for the maximum acres that might be treated in the first and last years to provide a range of maximum potential annual emissions over the course of the planning period.

Prescribed fire programs in Alternatives C, C-1, and D would produce the highest levels of $PM_{2.5}$ of all alternatives. Each of these alternatives would produce a maximum of 1,459 to 2,458 tons of $PM_{2.5}$ per year; the lower number representing the earlier years of the planning period, and the larger value the later years.

On average, the Forest has used prescribed fire on 5,698 acres annually since 1992, producing an estimated 227 tons of $PM_{2.5}$ emissions each year. In comparison, acres treated under Alternatives C, C-1 and D would increase and so would emissions. The largest prescribed fire program over the previous 10 years occurred in 1997 when 12,929 acres were treated. $PM_{2.5}$ emissions that year were estimated at 539 tons. Emissions from Alternatives C, C-1 and D could double the 1997 emissions in the early years of the planning period. By the end of the planning period, $PM_{2.5}$ emissions could be five times the 1997 levels.

CUMULATIVE EFFECTS

The larger prescribed fire programs proposed in Alternatives C, C-1, and D would increase primary $PM_{2.5}$ emissions in the analysis area by 10 to 22 percent. Additional prescribed fire activity anticipated in the analysis area would occur on the Big South Fork National River and Recreation Area, where approximately 300 acres per year might be burned (including lands in Kentucky and Tennessee). Emissions from these burns would contribute an estimated 13 tons annually to $PM_{2.5}$ concentrations. Addition of the Big South Fork emissions to the Alternative increases the prescribed fire contribution to overall $PM_{2.5}$ about one-tenth of one percent. Other land management agencies within the proclamation boundary also plan to burn grasslands, but at a level that would contribute negligibly to emissions.

Air Quality – Effects of Oil and Gas Leasing

The Forest Service is assessing the environmental consequences of leasing natural gas exploration and production rights on the Daniel Boone National Forest under a variety of alternatives. The primary criteria pollutant emissions from development of natural gas wells are nitrogen oxides (NO_x) and volatile organic compounds (VOC). In the presence of sunlight, these pollutants combine to form ozone, a regulated pollutant that affects vegetation and human health. There is one ozone monitor in the analysis area, located in Pulaski County, Kentucky. Data from this site suggests the possibility that this county will reach non-attainment for ozone (Table 3 - 1). This analysis seeks to estimate the potential air quality impacts of emissions from the proposed activities.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

[Note: There were no cumulative effects common to all alternatives.]

Air quality impacts from development of a natural gas field can be divided into two categories: construction of well sites and well production/operation. While the construction phase is relatively short, the production phase persists as long as the well produces gas.

Construction emissions include the pollutant emissions from well pad development, which involves three separate, sequential activities:

1) Clearing, grading, and construction of the road that connects the existing access road to the well pad site. Construction traffic over unpaved roads as well as tailpipe emissions from construction traffic produce fugitive dust emissions.
2) Rig-up, drilling, and rig-down. These activities consist of bringing equipment and supplies by truck to the well site, drilling a hole to the desired depth, and removing the drilling equipment. Pollutant emissions during this phase include the particulates from traffic on unpaved roads, vehicle tailpipe emissions, and exhaust emissions from drilling engines.
3) Completion and testing involves running pipe into the borehole and flaring small quantities of gas at the surface to evaluate well productivity. Pollutant emissions that occur during completion and testing include road dust from vehicle traffic, vehicle tailpipe emissions, and combustion products from the flaring of natural gas.

Gas produced from leased wells on the Forest would be collected and piped to a compressor station located on private land. The main source of emissions from the production phase would be from fugitive equipment leaks. Lesser emissions come from the heater-separator that is designed to separate liquids from the gas stream and the condensate storage tank that collects the liquids. Heat comes from burning some of the methane produced by the well.

The emission rates for construction and production activities are taken from a Bureau of Land Management report, "Environmental Assessment: Cooper Reservoir Natural Gas Development Project -- Cumulative Air Quality Impact Analysis (USDI BLM 1998, Appendix A). The Cooper Reservoir Project activities are similar to what would occur in gas field development in eastern

Kentucky, which makes it possible to use the pre-calculated emissions for this analysis. Activities are of similar duration, similar equipment, and both projects involve "sweet" gas which does not produce hydrogen sulfide during flaring.

The primary criteria pollutants emitted by producing gas wells include volatile organic compounds and nitrogen oxides (NOx), the primary criteria pollutants emitted during the construction phase. Each alternative has a specified maximum number of wells that could be put into production over the next two decades. The emissions from construction and operation of the "reasonably foreseeable development scenario" on the Forest are calculated and compared between alternatives for the direct and indirect effects analysis. Annual emissions of these pollutants were calculated based on projections of the number of wells developed each year over 20 years. Construction emissions were calculated and included only in the year the well was developed. Production emissions were included in the total emissions calculated for the year the well was constructed and in all years following, for 20 years. It was assumed that all wells developed would produce gas over the remainder of the 20-year analysis period. This would result in increasing emissions over time as incremental development of wells occurred. The range of annual emissions that could be produced over the analysis period is represented by a minimum and maximum value for each alternative shown in Table 3 - 4.

Table 3 - 4. Estimated annual air pollution emissions, in tons, resulting from projected gas well development on the DBNF.

	Direct Effects				Cumulative Effects			
	Annual Volatile Organic Compound Emissions (tons)		Annual Nitrogen Oxide Emissions (tons)		Annual Volatile Organic Compound Emissions (tons)		Annual Nitrogen Oxide Emissions (tons)	
Alt.	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
A	11	175	12	40	1,023	19,639	1,121	3,879
B-1	0	0	0	0	1,003	19,344	1,100	3,831
C	13	196	14	29	1,031	19,750	1,129	3,898
C-1	13	196	14	29	1,031	19,750	1,129	3,898
D	13	196	14	29	1,031	19,750	1,129	3,898
E-1	19	296	21	43	1,047	19,984	1,147	3,936
	Current EPA Emissions Inventory-1999				31,832		41,084	

ALTERNATIVES A, C, C-1, D, AND E-1

DIRECT AND INDIRECT EFFECTS

There is essentially no difference in air pollution emissions between the reasonably foreseeable development scenario for Alternatives A, C, C-1, D, and E-1. Emissions would be similar for these alternatives because the number of wells developed under each would be about the same. Volatile organics and nitrogen oxide emissions are calculated for the number of wells projected for construction and production in each year of the 20-year analysis period. The ranges of annual emissions that could be produced over the 20-year analysis period are represented by a minimum and maximum value for each alternative in Table 3 - 4.

CUMULATIVE EFFECTS

Emissions from private-rights wells on National Forest System lands and gas wells off-Forest are added to the emissions from the "reasonably foreseeable development scenario" to assess "Cumulative Effects." Development of gas wells under the leasing decision is completed by year 15 of the analysis, but the other wells would continue to be developed through all 20 years of the analysis. Projected emissions from all wells that could be developed in the analysis area are displayed in Cumulative Effects columns of Table 3 - 4. The minimum represents year-1 emissions and the maximum represents year-20 emissions. It is clear that emissions from wells developed under the reasonably foreseeable development scenario (Direct Effects), in any of the alternatives, would be only a fraction of those from private-rights wells on the Forest and gas wells off-Forest (Cumulative Effects).

Cumulatively, maximum emissions from all projected development could be about 62 percent of current inventoried VOC emissions. Maximum nitrogen oxide emissions are about 10 percent of the current inventory.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Alternative B-1 calls for no development of federally owned natural gas resources on the Forest. With no new wells drilled or operated, no additional emissions would be generated and existing air quality would not be affected. However, privately owned natural gas resources would remain open to development. Potential emissions from these sources are addressed under Cumulative Effects.

CUMULATIVE EFFECTS

Wells to recover privately owned natural gas resources on the Forest could be drilled and operated. Emissions from such development as well as emissions from wells on private lands within the vicinity of the Forest are presented in Table 3 - 4.

SOIL AND WATER

Affected Environment

Hydrologic Features

Kentucky has over 89,000 miles of perennial rivers and streams (Kentucky Division of Water 1998) of which about 7,400 miles lie within the Daniel Boone National Forest proclamation boundary. With so many perennial watercourses running through the forest area in addition to about 34,600 miles of ephemeral and intermittent streams, providing stream course protection and ensuring water quality is an important task for Forest managers. The DBNF manages between 6 and 10 percent of the watersheds within the Ohio River Basin, including portions of the Licking, Kentucky and Cumberland Rivers (Figure 3 - 1). Collectively, these watersheds cover 10.3 million acres or 40 percent of the state, providing surface and groundwater resources for more than one million people. The following section describes the major features of the segments of these three river systems that flow through the DBNF, including major tributaries and reservoirs as well as rivers with special designations. In the Environmental Consequences section of this chapter, each of the three major basins will be subdivided into 49 watersheds (Figure 3 - 2).

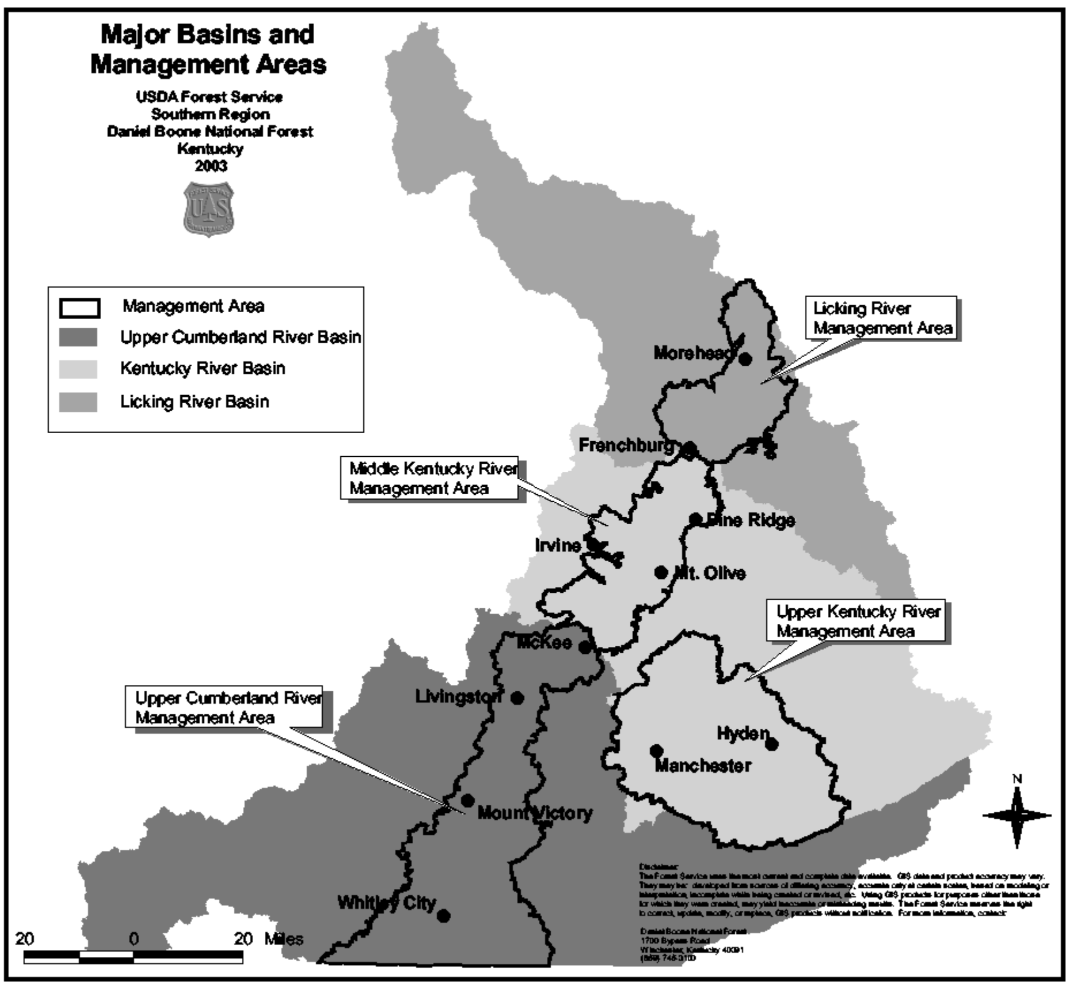

Figure 3 - 1. The relationship between major basins and Management Areas.

Cumberland River System: The headwaters of the Cumberland River flow from the Cumberland Mountains of southeastern Kentucky, an area with the highest elevations in the state. From the confluence of Poor and Clover Forks in Harlan County, the Cumberland River flows 308 miles, generally west and south through a gap in Pine Mountain and across the Cumberland Plateau and Highland Rim before entering Tennessee near the southeastern corner of Monroe County, Kentucky. The river then flows in a broad southward arc in north-central Tennessee, turning northwestward through Nashville and reentering Kentucky in south-central Trigg County. The two segments within the DBNF Proclamation Boundary are the middle segment, which includes drainages from Cumberland Falls downstream to the Kentucky-Tennessee border, and the upper segment, which includes the basin above Cumberland Falls (Burr and Warren 1986). The combination of these two segments, designated as the Upper Cumberland River Management Area, include approximately 50 percent of National Forest System land with the DBNF.

Middle Cumberland River Drainage: Most of the middle Cumberland River drainage lies in the Highland Rim of Kentucky and Tennessee and the Central Basin of Tennessee (Quarterman and Powell 1978), although portions of the basin drain the Cumberland Plateau. The Kentucky portion of this segment encompasses 5,016 square miles, of which roughly 10 percent is National Forest System land. In an upstream direction, major tributaries of the Kentucky portion of the middle basin include the Big South Fork, Rockcastle, and Laurel Rivers. The mainstream is dammed in southwest Russell County to form Lake Cumberland, a 50,230-acre reservoir, which impounds the lower reaches of tributaries upstream to the confluence of Laurel River. Laurel River is impounded above its confluence with the Cumberland River, forming a 6,056-acre reservoir that floods a considerable portion of its tributaries. The area is heavily forested and scenic, containing some of the most pristine waters remaining in the state. Four stream and river segments in the basin have been designated Kentucky Wild Rivers including a 13.3-mile segment of the lower Rockcastle River, a 10.2-mile segment of Little South Fork, an 17.5 mile-segment of Rock Creek, and a 10.1-mile segment of Big South Fork. A portion of the Big South Fork also is part of a National River and Recreation Area managed by the National Park Service. Both Rock Creek and Rockcastle River are being considered for designation as national wild and scenic rivers (USDA Forest Service 1992, 1994a). Streams and rivers of the middle Cumberland River are upland in nature with alternating riffles and pools, incised meanders, narrow flood plains, and rocky substrates. Streams and rivers bordering or heading on the sandstone-capped Southwestern Escarpment and Cumberland Plateau (i.e., Rockcastle, Laurel, and Big South Fork Rivers) have high gradients with low waterfalls, boulder-strewn swift shoals, and deep holes. Creeks and streams draining the Cumberland Plateau immediately below Cumberland Falls also are high gradient, and several have falls near their mouths. These falls and hanging valleys were created by the upstream progression of Cumberland Falls (Burr and Warren 1986).

Upper Cumberland River Drainage: The Upper Cumberland River Drainage includes about 1,977 square miles above Cumberland Falls. The mainstream of the river begins at the confluence of Clover Fork and Poor Fork near Harlan in the southeastern most part of Kentucky. From its headwaters, the Cumberland River drains the Cumberland Mountains to the southeast and the Pine Mountain Overthrust to the northwest. The Cumberland River is joined from the north by Straight Creek before entering the Cumberland Plateau near Pineville. Other major tributaries entering from the north include Stinking, Richland, and

Watts Creeks. Many southern tributaries, including Clear Fork, Jellico, and Marsh creeks, have their headwaters in northern Tennessee. Near the mouth of Marsh Creek, the mainstream abruptly turns north before plunging 55-feet over Cumberland Falls. Cumberland Falls probably originated near Burnside, Kentucky about 45 miles downstream of its present position, and the upstream progression of the falls has left a 400-foot wide gorge through the surrounding Cumberland Plateau. A 14.9-mile section of the Cumberland River (including Cumberland Falls) in McCreary and Whitley Counties is a Kentucky Wild River and has been proposed for National Wild and Scenic River designation. Marsh Creek in McCreary County also has been proposed for federal designation (USDA Forest Service 1992, 1994). The creeks, streams, and rivers of this basin are examples of the most scenic and pristine upland waters in Kentucky. Tributaries draining the Cumberland Mountains and Pine Mountain Overthrust have extremely high gradients and few pools but numerous riffles, waterfalls, and large sandstone substrates. Most Upper Cumberland streams in the DBNF begin on the Cumberland Plateau. Tributaries draining the Cumberland Plateau are similar although they originate at lower elevations than tributaries draining the Cumberland Mountains and the Pine Mountain Overthrust. Extensive reaches of the Cumberland River mainstream and its large tributaries flow over bedrock and contain long boulder- and cobble-strewn shoals and deep, rocky pools. The substrates of the region are sandstone, shale, siltstone, and coal (Burr and Warren 1986).

Licking River System: The Licking River system begins on the Cumberland Plateau in Magoffin County and flows northwestward through the Bluegrass Region for about 310 miles before joining the Ohio River near Covington. The basin encompasses approximately 3,707 square miles, of which six percent is managed by the DBNF. Two major tributaries, the North and South Forks, join the river near Milford and Falmouth. The basin is bounded on the north and northeast by the Ohio River, Kinniconick Creek, Tygarts Creek, and Little Sandy River drainages; on the east by the Big Sandy drainage; and on the south and southwest by the Kentucky River drainage. The Licking River is dammed near Morehead to form Cave Run Lake (8,267 acre), which impounds 38 miles of the main stem, as well as the lower reaches of several tributaries. The creeks, streams, and rivers of the basin are generally upland, having moderate- to high-gradients, well-developed riffles and shoals, rocky substrates, and poor to moderate flood plain development (Burr and Warren 1986). This watershed, within the Proclamation Boundary, has been designated as the Licking River Management Area. Approximately 17 percent of the lands managed by the DBNF are within the Licking River basin or Management Area.

Kentucky River System: The headwaters of the Kentucky River system flow from the rugged mountain area along the Pine Mountain Overthrust on the Cumberland Plateau. The DBNF manages approximately six percent of the 6,966 square mile watershed. From the confluence of the North, Middle, and South Forks near Beattyville, the river flows northwestward 256 miles through the Bluegrass Region before joining the Ohio River near Carrollton. Major tributaries from the mouth upstream include Eagle Creek, Elkhorn Creek, Dix River, Red River, and the North, Middle, and South Forks. A 19.4-mile section of the Red River has been designated a Kentucky Wild River and a National Wild and Scenic River (USDA Forest Service 1992, 1994a). War Fork Creek in Jackson County is proposed for federal designation. Buckhorn Lake (1,230 acres) on the Middle Fork in Leslie and Perry Counties is the only major flood control and recreational reservoir within the Kentucky River system that is within the DBNF proclamation boundary. The streams and rivers of the basin have been characterized as upland; however, many smaller streams in the Bluegrass section are intermittent, and have hanging valleys up to their confluence with the main stream. Locks and dams that extend along the main stem from near the mouth upstream to Beattyville. The pooling of much of the mainstream and the lower reaches of many tributaries resulted in the loss of most riffle and shallow water habitat (Burr and Warren 1986). The Kentucky River basin within the proclamation boundary has been divided into two Management Areas, the (Middle Kentucky River and Upper Kentucky River). Approximately 12 and 21 percent of the lands managed by the DBNF are within the Middle and Upper Kentucky basins or Management Areas respectively.

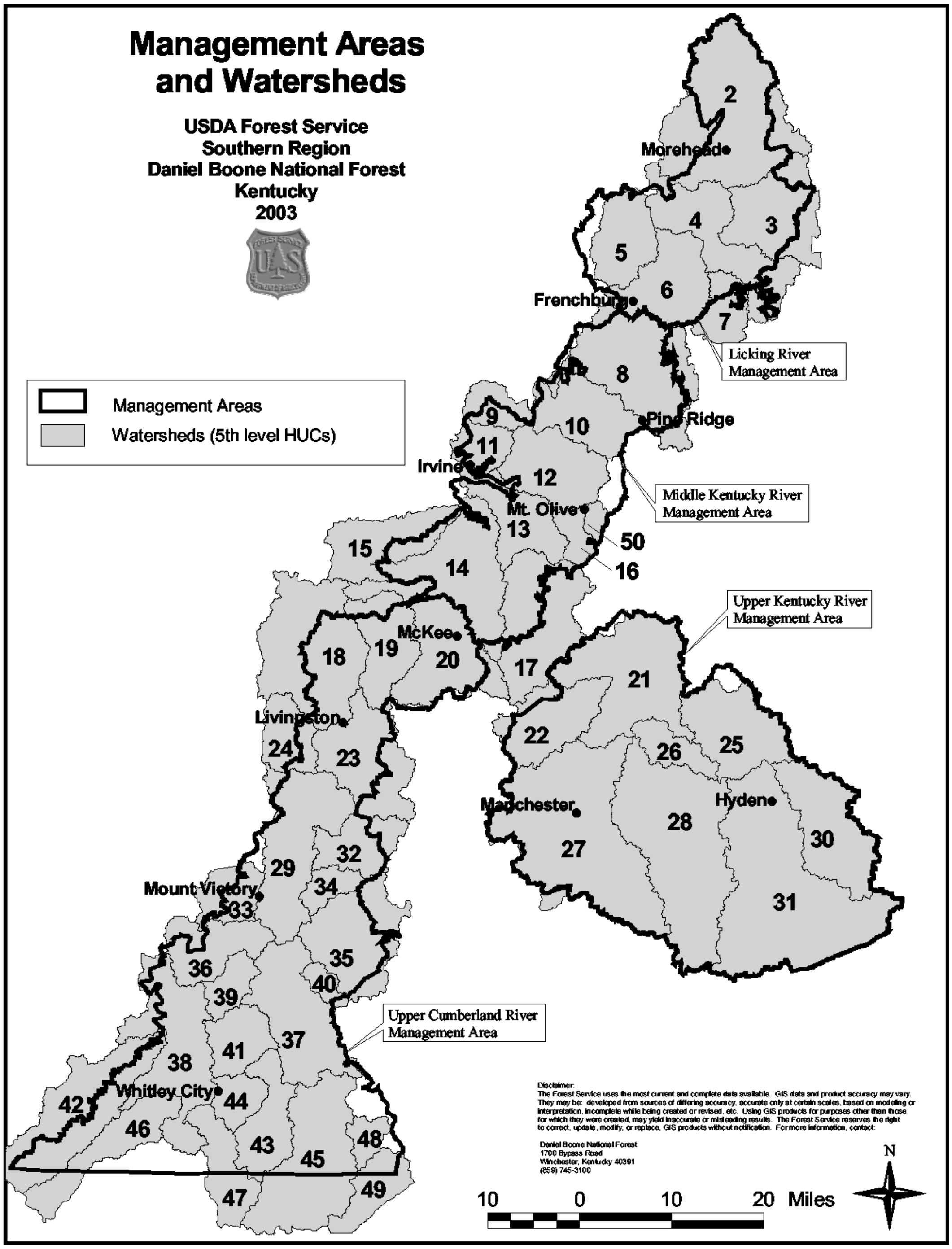

Figure 3 - 2. The relationship between Management Areas and watersheds.

Soils

Currently about 90 different soils have been mapped and classified on the Forest and are included in 280 mapping unit delineations, representing one or more soils. The dominant kinds of soils on the Forest, their location and extent, can be described in such brief and general terms as: deep, fine-loamy and fine-silty soils occurring on alluvial bottoms and terraces, on about four percent of the Forest; moderately deep to deep, fine-loamy, coarse-loamy and loamy-skeletal soils occurring on gently sloping to steep side-slopes and deep, fine-loamy soils in coves, on about 73 percent of the Forest; and moderately deep to deep fine-loamy, fine-silty, fine, and clayey textured residual soils appearing on ridgetops and upper ridge crests, on about 23 percent of the Forest. Productivity, as related to tree growth, ranges from about 10 cubic feet/acre/year on shallow (<20 inches to bedrock), loamy-skeletal soils, usually in association with rock outcrops, to greater than 133 cubic feet/acre/year on deep (>40 inches to bedrock), well-drained soils found in flood plains, terraces, benches, toe slopes and coves. Shallow soils comprise less than one percent of the Forest and occur as either minor soils in a mapping unit name or as inclusions described in the mapping unit description, but not included in the mapping unit name.

Soils forming from mixed alluvial materials (e.g., limestone, quartzose sandstone and shale and siltstone) on terraces and flood plains are predominately well-drained, fine-sandy loam, loam and silt loam soils with high moisture availability and moderate fertility. Less extensive soils are somewhat poorly drained or have a fragipan, which restricts root growth and permeability. Riparian area soils, gravelly and cobbly loams, fine sandy loams, and sandy loams, developing from moderately coarse and coarse textured sediments, yield higher quality aquatic habitats (stable stream banks, clean, open-graded substrates, lower turbidities) than silt loam and loamy textured soils developing from silty alluvium (less stable stream banks, higher sediment yields, silty substrates, and increased turbidity). Soils in riparian areas generally exhibit distinct features that are influenced by flooding and/or a water table. Riparian soils will typically have free water (water table) available for plant use at some time during the growing season.

Soils on ridges are forming in weathered residuum from acid shale, siltstone, and sandstone, and to a limited extent, limestone, and carbonaceous shale and siltstone. They are mostly moderately deep-to-deep, well-drained, loam, silt loam, and silty clay loams with moderate fertility.

Soils on upland slopes are usually formed from colluvial materials of mixed mineralogy, derived from a variety of rock types. In cove positions, deep, well-drained silt loam and sandy loam soil have developed, offering highly productive growing sites. Soils on steep upper slopes range from moderately deep to shallow. They are well drained with the gravelly and channery silt loam and sandy loam textures commonly associated with rock outcrop. These soils generally have severe erosion potential from exposed or bare soil areas and a greater risk of slope failure. Soils in mid-slope and toe or lower slope positions are usually deep, well-drained, gravelly silt loams. Those below prominent sandstone cliffs are usually sandy loams.

Soils on the forest east of the Highland Rim (the Eastern Karst Plain subsection, the Knobs and Cliff subsections to the north), with the exception of the broader river valleys, have basically 40 to 80 percent quartz with some mica in the sand and silt size fraction. In the area of the Knobs subsection, soils have less than 60 percent quartz and mica minerals. Soils in the broad river bottoms along the Upper Cumberland and the Licking Rivers have sand and silt content comprised between 40 and 80 percent quartz.

Current Conditions

Soil Erosion: Erosion caused an annual loss of more than 86 million tons of soil from Kentucky lands from 1992 to 1996, according to the 1997 National Resource Inventory (USDA NRCS 1997), making it the state's most serious land management problem. Most people recognize, however, that well-managed forests are one of the most effective means of protecting watersheds.

Forests cover about one half of Kentucky's 25 million acres. However, vegetation management activities statewide, and particularly on the DBNF, generate a relatively small percentage of the total sources of non-point source pollution. Sheet and rill erosion in forests is of minor consequence. Channel and gulley erosion, though, is estimated to account for about two-thirds of the erosion and sediment yield problems in forested watersheds. Much of this is associated with roads. Most erosion and sediment yields originate from poorly maintained roads, many of which are not under Forest Service or other government jurisdiction, or from roads and skid roads associated with old logging operations on intermingled private property. In contrast, the land use generating the greatest loss of soil within the state is mining. In the mountains of eastern Kentucky, nearly 38 million tons of soil was eroded from 5 million acres from 1992 to 1996, according to the 1997 National Resource Inventory (USDA NRCS 1997). Eighty-seven percent of this loss comes from about 158,000 acres, 60 percent of which was strip mined for coal.

The biggest factor contributing to the amount of soil loss by erosion is the amount of bare soil created by an activity. With exposure comes the potential for soil movement through and off the areas where the disturbance occurs. Other important factors in soil erosion include soil texture, organic matter, infiltration/permeability rates, and slope. The highest sediment yields occur during the larger rainfall events. Since about 80 percent of estimated annual runoff and peak flood events occur from December through May, soils are more susceptible to erosion during this period.

Slope disturbances produced by construction of roads, skid roads, and log landings, etc., can potentially initiate or accelerate existing soil mass movement by undercutting or loading a slope, or disrupting established drainage patterns. Internal soil strength and external factors (e.g., root systems, ground water supplies, bedrock type) are important aspects of slope stability. Of particular concern are soils developing from shale's of these following formations or formation members: Beattyville, Hartselle, Magoffin, Pennington, Nada-Cowbell, and Nancy. These shale's weather to plastic clays, which increases the risk that soils will slump when subjected to a rapid rise in groundwater or concentrations of overland flow.

Slope stability on the Forest is of concern where soils are forming from soft incompetent shale's on steep slopes. These readily weather to plastic clays that are sensitive to disturbance or disruption of the hydrologic balance (e.g., a rapid rise in ground water). In many areas on the forest, topographic, lithologic, or structural conditions are particularly susceptible to landslides and debris flows when disturbed by road construction/reconstruction or logging. Such incipient slope failures can exert a tremendous impact on soil and water resources and cause serious economic losses due to blocked streams, degraded water quality, and loss of soil productivity. Accordingly, those engaged in locating, designing, constructing and maintaining roads, planning timber sales, and mineral development, etc., should be aware of how slope and groundwater interact with various sensitive soils and geologic formations. Not all landslides can be prevented, but they can be controlled, thus minimizing adverse effects to soil productivity and the benefits, functions and values of riparian areas and wetlands as well as water quality and aquatic habitats.

Stream Sedimentation and Water Quality: Soil erosion is the detachment and transport of individual soil particles by wind, water and gravity. Erosion not only reduces soil productivity, soil particles reaching streams as sediment, potentially lower the productivity of aquatic ecosystems. This, in turn, adversely affects various consumptive and non-consumptive uses. Sediment is the state's second leading cause of stream impairment, according to Kentucky's 2002 Clean Water Act 305b Report to Congress.

When soil erosion reaches the stream network, it is called stream sedimentation. The DBNF quantifies stream sedimentation using the Watershed Condition Rank (WCR) procedure developed by the Forest Service's Southern Region. Based on current as well as anticipated sediment load increases, WCR rankings indicate the condition of 5th level watersheds (Figure 3 - 2). A brief account of the process, as well as current conditions, follows. A full explanation of the process can be found in the process record for this Final Environmental Impact Statement.

To establish WCRs, the current sediment average annual yield is determined and expressed as a percentage above baseline conditions. Baseline conditions are calculated by removing all sedimentation attributed to present human influences in the analyzed watersheds. Next, the relative abundance of locally adapted species with respect to predicted sediment increases is used to determine a species-sediment load relationship or index (SSI). This score is modified using a weighted average when a watershed occurs in more than one physiographic zone. Watershed conditions are divided into three categories of Excellent, Average and Below Average. The SSI, however, does not necessarily indicate a precise watershed condition. It broadly categorizes watersheds based on the sediment prediction/aquatic viability relationship. As a relatively large-scale coarse filter used to evaluate forest plan alternatives, the SSI is a tool to help establish priorities at the planning level. Further, detailed analyses of watersheds are conducted at the project level.

WCR calculations are useful in the development of forest plan objectives. The following section details WCR outcomes with respect to adverse effects on aquatic biota as they are related to forest management:

> A watershed SSI of Excellent indicates a Low probability for adverse effect to aquatic species. If the results of a forest plan alternative remain within this range there should be no adverse effect on water quality with respect to beneficial uses (fish communities). Forest plan objectives, therefore, would focus on maintaining or improving aquatic health through the implementation of management prescriptions that support riparian values.
>
> A watershed SSI of Average**,** indicates a Moderate probability for adverse effects on beneficial uses. In this case, forest plan objectives should stipulate that watershed assessments be conducted during project planning to identify pollution sources. Additionally, objectives should provide for monitoring prior to project implementation to determine actual health of the biota.
>
> A watershed SSI of Below Average, indicates a High potential for adverse effects to beneficial uses. In addition to the objectives listed above, forest management at the project level should seek to maintain or restore watershed health and aquatic systems where Forest Service actions can make meaningful contributions to watershed health. Forest plan prescriptions should be applied in an effort to correct unhealthy situations.

The sediment model and the WCR both rely on numerous assumptions. To minimize any misunderstanding, every effort has been made to acknowledge assumptions and describe them clearly. In light of these assumptions, however, neither the sediment model nor associated WCR should be regarded as absolutes. At the forest plan level, they are useful in comparing the outcomes that would likely result from the various alternatives. Regardless of assumptions or methods, the overall intention remains the reduction of risk to water quality and aquatic biota.

Watershed condition, expressed at the outfall of the watershed, reflects accumulation from disturbances across the entire watershed. Subwatersheds within a 5th level watershed will have a range of conditions. The conditions of subwatersheds and the determination of effects will occur at the project level.

On the DBNF, watersheds would fall into either the Excellent or Average category for stream sedimentation (Table 3 - 5). This is to be expected for 5th level watersheds on the Forest since most of the Daniel Boone is forested and under relatively strict erosion control measures or Best Management Practices (BMP). However, other water quality problems exist and are discussed in the paragraphs below.

Table 3 - 5. Watershed conditions by Management Area.

Watershed # (Figure 3 - 2)	Hydrologic Unit Code	Square Miles	Percent NFS Lands	Percent Increase over Baseline	Excellent Range	Average Range	Below Average Range	Species Sediment Load Index (SSI)*
Upper Cumberland River Management Area								
49	05130101350	39.6	5	1578	0 - 2200	2201 - 4700	> 4700	E
48	05130101360	16.7	17	944	0 - 2200	2201 - 4700	> 4700	E
37	05130101370	103.8	58	905	0 - 2200	2201 - 4700	> 4700	E
45	05130101400	130.9	19	571	0 - 2200	2201 - 4700	> 4700	E
43	05130101410	55.5	30	1441	0 - 2200	2201 - 4700	> 4700	E
44	05130101420	26.1	62	2123	0 - 2200	2201 - 4700	> 4700	E
41	05130101430	41.5	72	816	0 - 2200	2201 - 4700	> 4700	E
40	05130101440	12.8	54	864	0 - 2200	2201 - 4700	> 4700	E
35	05130101450	95.9	39	3196	0 - 2200	2201 - 4700	> 4700	A
20	05130102030	86.4	45	1393	0 - 2200	2201 - 4700	> 4700	E
23	05130102040	93.5	10	2094	0 - 2200	2201 - 4700	> 4700	E
19	05130102050	61.8	39	999	0 - 2200	2201 - 4700	> 4700	E
18	05130102060	143.8	7	2228	0 - 2200	2201 - 4700	> 4700	A
29	05130102070	112.9	47	1174	0 - 2200	2201 - 4700	> 4700	E
24	05130102080	40.6	4	677	0 - 2200	2201 - 4700	> 4700	E
32	05130102090	47.5	34	2366	0 - 2200	2201 - 4700	> 4700	A
34	05130102100	20.4	90	463	0 - 2200	2201 - 4700	> 4700	E
36	05130103010	56.8	61	990	0 - 2200	2201 - 4700	> 4700	E
39	05130103020	25.1	95	565	0 - 2200	2201 - 4700	> 4700	E
33	05130103040	37.8	10	908	0 - 2200	2201 - 4700	> 4700	E
38	05130104250	117.7	43	942	0 - 2200	2201 - 4700	> 4700	E
47	05130104270	49.7	6	1741	0 - 2200	2201 - 4700	> 4700	E
46	05130104290	62.6	61	546	0 - 2200	2201 - 4700	> 4700	E
42	05130104310	122.0	5	1131	0 - 2200	2201 - 4700	> 4700	E

(Table 3 – 5 cointues on next page)

Watershed # (Figure 3 - 2)	Hydrologic Unit Code	Square Miles	Percent NFS Lands	Percent Increase over Baseline	Excellent Range	Average Range	Below Average Range	Species Sediment Load Index (SSI)*
(continued from previous page)								
Licking River Management Area								
4	05100101040	98.9	57	1407	0 - 2200	2201 - 4700	> 4700	E
7	05100101090	34.5	11	1817	0 - 2200	2201 - 4700	> 4700	E
3	05100101100	85.0	32	974	0 - 2200	2201 - 4700	> 4700	E
6	05100101110	72.8	37	921	0 - 2200	2201 - 4700	> 4700	E
2	05100101130	186.5	30	1813	0 - 2200	2201 - 4700	> 4700	E
5	05100101140	56.0	28	1255	0 - 2200	2201 - 4700	> 4700	E
Middle Kentucky River Management Area								
16	05100204010	18.0	3	849	0 - 2200	2201 - 4700	> 4700	E
17	05100204020	110.9	9	1574	0 - 2200	2201 - 4700	> 4700	E
13	05100204030	60.0	10	1313	0 - 2200	2201 - 4700	> 4700	E
12	05100204040	74.8	9	828	0 - 2200	2201 - 4700	> 4700	E
14	05100204050	120.2	27	878	0 - 2200	2201 - 4700	> 4700	E
11	05100204060	27.8	11	1138	0 - 2200	2201 - 4700	> 4700	E
15	05100204070	69.8	2	1407	0 - 2200	2201 - 4700	> 4700	E
8	05100204120	134.2	50	1076	0 - 2200	2201 - 4700	> 4700	E
10	05100204140	66.4	21	1073	0 - 2200	2201 - 4700	> 4700	E
9	05100204170	27.3	9	1108	0 - 2200	2201 - 4700	> 4700	E
50	05100201230	8.3	0	1551	0 - 2200	2201 - 4700	> 4700	E
Upper Kentucky River Management Area								
31	05100202010	242.8	8	866	0 - 2200	2201 - 4700	> 4700	E
30	05100202020	92.0	0	1587	0 - 2200	2201 - 4700	> 4700	E
25	05100202030	84.2	19	443	0 - 2200	2201 - 4700	> 4700	E
28	05100203010	195.6	61	637	0 - 2200	2201 - 4700	> 4700	E
21	05100203020	129.8	17	634	0 - 2200	2201 - 4700	> 4700	E
26	05100203030	29.5	35	321	0 - 2200	2201 - 4700	> 4700	E
27	05100203040	228.6	14	902	0 - 2200	2201 - 4700	> 4700	E
22	05100203050	71.3	8	875	0 - 2200	2201 - 4700	> 4700	E

** Species Sediment Load Index (SSI): E = Excellent, A = Average

Other Activities Affecting Water Quality: As discussed above, erosion and stream sedimentation are the major water quality problems affecting the Forest. There are other pollutants that are causing serious impacts in several watersheds, however. These include mineral extraction, sewage discharge, and agricultural run-off.

Within the proclamation boundary, 331 miles of stream do not support or only partially support beneficial uses, e.g., recreation and aquatic life (Kentucky Division of Water 1996; Table 3 - 6). Only 21 of these stream miles flow through National Forest System land (Table 3-6a).

Sedimentation and acid mine drainage from abandoned surface and underground coal mines; brine and oil residue from oil drilling; sedimentation and runoff of agricultural chemicals and animal wastes from farm lands; discharge from domestic wastewater systems; and sedimentation from roads and timber harvest constitute the primary water quality issues facing the DBNF. The source of many of these problems can be found on private lands near or adjacent to the Forest.

Table 3 - 6. Miles of impaired streams within the DBNF proclamation boundary.

MANAGEMENT AREA	River Basin	Miles of Impaired Streams
Licking River	Licking	1.0
Middle Kentucky River	Kentucky	91.0
Upper Kentucky River	Kentucky	115.9
Cumberland River	Cumberland	117.7
	Total	330.8

(KY DOW 1996)

Table 3 - 7. Miles of impaired stream on National Forest System land.

Watershed # (Figure 3 - 2)	Hydrologic Unit Code	Miles of Impaired Streams
Licking River Management Area		
5	05100101140	0.0
Middle Kentucky River Management Area		
8	05100204120	1.2
10	05100204140	1.0
Upper Kentucky River Management Area		
28	05100203010	0.2
Upper Cumberland River Management Area		
19	05130102050	0.5
20	05130102030	0.3
23	05130102040	0.9
29	05130103070	4.7
32	05130102090	0.0
34	05130102100	0.0
36	05130103010	0.7
38	05130104250	1.8
39	05130103020	0.6
41	05130101430	1.7
44	05130101420	1.6
45	05130101400	0.5
46	05130104290	2.3
47	05130104270	2.8
	Total	21.4

(KY DOW 1996)

Water Use: The U.S. Department of Interior Geological Survey has estimated the nation's water use at five-year intervals since 1950. Early estimates were for whole states and even larger watersheds. In 1985, however, the agency began estimating use for counties and watersheds (hydrologic units) that tend to be slightly larger than a typical county. State totals for these periodic surveys of water use have been published in Geological Survey circulars. The Geological Survey also provides detailed water use and supply estimates as data files (USGS 2002). For this Draft Environmental Impact Statement, water use information was retrieved by 4th level hydrologic unit (HUC) and then aggregated by Management Area (Figure 3 - 1). Estimates are reported for total ground water and surface-water uses including domestic, municipal, industrial, agricultural (for irrigation), thermoelectric (largely for cooling), and hydroelectric uses (Table 3 - 8). Of the water withdrawn, a portion is consumed (e.g., by being incorporated into a product or evaporated from an irrigated field) and is removed from the immediate water environment; the remainder returns to the stream or perhaps seeps into ground water storage and is available for reuse.

Table 3 - 8. Water use in millions of gallons per day by Management Area.

MANAGEMENT AREA	Year	Ground-water Use	Surface-water Use	Total Use
Licking River	1985	3.62	24.05	27.67
	1990	5.19	21.92	27.11
	1995	2.46	34.65	37.11
Middle Kentucky River	1985	4.01	8.35	12.36
	1990	4.42	13.44	17.86
	1995	2.71	13.15	15.86
Upper Kentucky River	1985	1.74	2.08	3.82
	1990	1.81	3.39	5.20
	1995	1.27	6.65	7.92
Upper Cumberland River	1985	6.23	255.44	261.67
	1990	7.58	416.45	424.03
	1995	3.74	420.57	424.31

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS COMMON TO ALL ALTERNATIVES

The following discussion provides some background information regarding the direct environmental effects common to soil and water resources from management activities. Any activity that disturbs the land surface, decreases cover or alters vegetation can affect soils, water yield and degrade water quality. The primary management activities that could affect the soil resource, water yield, and water quality are:

- Roads and Trails
- Vegetation Management

- Mineral Exploration
- Fire Management

Roads and Trails: Roads and trails directly and indirectly affect water by increasing sedimentation and concentrating runoff. Roads and trails expose and compact soils, alter surface and subsurface water flow, and can alter stream channels during construction. When left open they will contribute to higher erosion and sedimentation rates than closed roads and trails.

Vegetation Management: Vegetation management activities that affect soil and water are timber harvesting, site preparation, timber stand improvement projects, and skid trail construction. Loss of the protective soil cover (litter) from ground disturbance can increase erosion and sedimentation while decreasing soil productivity. Water yield also increases because of reduced transpiration and raindrop interception.

Mineral Exploration: Mineral exploration and development can affect soil and water by increasing erosion and sedimentation, soil compaction, and water yield. In many cases soil productivity is reduced and sediment can affect water quality. The potential seepage or spillage of toxic substances from mining facilities or disposal areas may also pose a threat to water quality.

Fire Management: Prescribed burning directly affects soil and water by removing a portion of the vegetative cover, which exposes soil to erosion. Control lines also expose mineral soil. These factors can reduce soil productivity and increase stream sedimentation. The significance of this varies widely depending on the soils, topography and the intensity of burn.

Since many of the activities proposed in the Forest Plan result in the same impacts to the soil and water resource the individual effects will be addressed in the following sections. At this scale of planning, the following discussions will be somewhat general in nature, more qualitative than quantitative.

Erosion and Sedimentation

The principal activities that raise the likelihood erosion and stream sedimentation are road construction, construction of log landings, skid roads, mechanical site preparation, and construction of drill pads for exploration and production of oil and gas and illegal use of off-highway vehicles (OHVs). The key to sustaining soil productivity and their hydrologic functions and water quality in the long-term is protection of the forest floor and associated soil properties and qualities through implementation of a mix of Best Management Practices (BMPs). Implementation of BMPs can safeguard long-term soil productivity and the hydrologic functions of soils as susceptible to erosion. With successful revegetation of bare soil areas, erosion and sedimentation rates should diminish rapidly to pre-disturbance levels within three years. The greatest decrease in these respective rates should be achieved in the first two growing seasons.

Soil erosion risk is greatest immediately after soil disturbing activities are completed. If Best Management Practices (e.g. structural drainage controls and revegetation) are followed, however, soil loss is usually negligible by the third and fourth year (Burger, 1985). Erosion damage associated with vegetation management activities is, therefore, largely preventable. The most effective way to reduce soil erosion is to limit the area disturbed as well as the area of bare soil conditions.

Although normally an added cost and complexity, cable logging systems are most effective in reducing adverse effects of timber harvest on soils and water quality. Carefully planned harvests that employ cable logging can reduce access needs (e.g. temporary roads, skid roads) by about 25 to 50 percent when compared to harvest that rely on ground-based or conventional logging equipment, such as tracked and wheeled skidders or even draft animals (Patric 1984).

Soil Displacement

The horizontal displacement of mineral surface soil layers rich in organic matter from one place to another through mechanical means (e.g., skidding of logs, blade construction of skid roads, landings, temporary and system roads, etc.), as well as accelerated and natural erosion, can reduce nutrient supplies and available soil water and increase soil densities. All of these are important to plant growth. Different soils have varying sensitivity to displacement of surface layers due to variation in soil properties and qualities (e.g., topsoil depth, texture, structure, and stoniness) and other factors (e.g., slope, vegetative cover). The degree of displacement may increase with increasing slope gradient. Soil loss can directly impair short- and long-term productivity because soil is a non-renewable resource. Root damage from skidding of logs and mechanical scattering may reduce tree vigor and resistance to disease and insect damage. Since over 60 percent of the fine root system (biomass) occupies the top eight inches, over 80 percent in the surface to 16 inches, and over 95 percent in the top 40 inches of deep soils, minimizing soil displacement to protect long-term productivity is imperative.

Soil Compaction

Soil compaction impacts can alter soil structure, reducing the larger pores and pathways in the soil, decreasing macrospore space, infiltration, and permeability (macrospores are soil voids >14 micrometers (um) or millionths of a meter), and increasing soil density. This will increase runoff, erosion, and stream sedimentation. In addition, when compaction approaches the projected growth limiting density for tree roots (Daddow and Warrington 1983), it reduces the volume of soil available for exploitation by tree roots as well as the productive potential of the impacted area (Gent, Jr. et al. 1983; Tworkoski et al. 1983).

The extent to which a forest soil is compacted depends on the kinds of equipment used (e.g., tracked, rubber tired, or low ground pressure equipment and cable systems), their weight, the number of trips made over the same area, the volume of timber skidded, and the depth of litter/duff layers and presence of slash, soil textures, structure, and soil moisture content. Designating the location of skid roads, however, can reduce the area of compaction and protect soil productivity. The compacted area can be reduced by spacing skidding routes as evenly as possible throughout the harvest area, providing soil resource protection and economic efficiency. Winching or end lining logs to the machine rather than driving the machine from a skid road/trail to each individual log also decreases the area compacted.

The impacts of compaction on plant growth can persist for as long as several decades, depending on the kind of soil and degree of impact. Even with soil tillage (e.g., ripping, subsoiling, or disking) these impacts cannot be fully alleviated in the short-term. Tillage with the proper equipment and under optimum soil conditions, however, can improve plant survival and growth substantially (estimated 30-75 percent) in the short-term. Tillage can improve soil recovery over the natural processes of freezing and thawing and wetting and drying cycles, animal activity, and root growth.

The potential loss in productivity from compaction is an important consideration on the forest in that approximately 70 percent of the soils occurring on slopes most favorable for conventional or crawler tractors and wheeled skidders (<35 percent slopes) have medium to high compaction hazard. Additionally, these soils are generally the most productive on the forest as well.

Slope Stability

Slope stability involves a complex interaction of soil shear strength, soil depth, slope gradient, ground water rise as related to precipitation and tree root strength. Decisions regarding slope stability cannot be made without risk. All sloping soils seek to achieve a flat gradient over time as influenced by erosion and landslides. Assessments of stability and risk/hazards should be correlated with geologic formations/bedrock types frequently associated with slope failures (e.g., characteristics such as competency or rock strength, lithologic discontinuities, hydrogeological conditions/hydraulic conductivity and porosity, weathering, clay mineralogy, and strike and dip of beds). Risk ratings of “severe or moderate” do not necessarily indicate an imminent or incipient failure, however. Such ratings mean only that serious adverse impacts are likely if a rapid rise in groundwater occurs.

Timber harvest systems that leave live trees spaced throughout the harvest area (e.g., shelterwood harvest) help provide stability by maintaining an abundance of live roots and a level of evaporation/transpiration from the residual trees. This reduces pore water pressure in the soil profile, increasing shear strength or resistance to a potential slope failure. The greater residual basal area left remaining after harvest and site preparation, the greater the significance of this benefit.

Water Quantity/Water Use

Most water quantity or water yield changes in streams on the DBNF over the life of the 2004 Forest Plan would be related to vegetation manipulation. Water yield in the streams typically increase temporarily after harvesting. This is caused by soil compaction and the removal of vegetation that would normally intercept and transpire rainfall. Most water yield increases from National Forest System lands are usually small and may not correlate with or alter peak flows. These changes in water yield usually augment summer low-flows (Swank, et al. 1989). Much depends on soil and site conditions, storm intensity and duration, as well as antecedent soil moisture conditions (Lull and Sopper 1966; Anderson et al. 1976). The amount and duration of this increase also depends on the percentage of basal area removed as well as forest type. Timber harvesting in pine generates a greater increase in total water yield than hardwoods or mixed pine-hardwood types. A 91 percent recovery in water yield can be expected within 10 years after removing 95 percent of the basal area in hardwood forest types. This recovery would take slightly longer for pine but would be quicker for partial cuts or thinnings. In all the alternatives most vegetation manipulation would be done with partial cuts. Because of southern pine beetle (SPB) infestation, very little pine would be harvested. However, the water yield changes from SPB affected areas were taken into account. The increase in surface runoff may cause some soil movement, minor stream bank cutting, and possibly stream sedimentation, but these increases may also temporarily increase aquatic species habitat in headwater areas by providing more water during summer low-flow.

To evaluate indirect effects of the alternatives, projected increases in total water yield were determined using an equation developed by researchers at the U.S. Fish and Wildlife Service Coweeta Research Laboratory for the Appalachian Mountains (Douglas and Swank 1972, 1975).

Although the equation was modified to better represent conditions on the DBNF, the reliability of these changes are predicted to be only within one level of magnitude of actual water yield increases (Chalfant 1990). Water yield would also vary according to the percentage of the watershed harvested and the location of harvest units within the watershed. Predicted water yield changes are, therefore, best used for comparison of alternatives and not as absolute values.

The projected water yield increases were also compared to water use in each of the Management Areas/watersheds (USGS 2002). Currently, water supply vastly exceeds use in most areas of the four main watersheds. In a few locations, however, use has risen to consume a substantial portion of the supply, especially during drought conditions. Future water demand is expected to follow population growth.

CUMULATIVE EFFECTS COMMON TO ALL ALTERNATIVES

Erosion and Sedimentation

Sedimentation originating from both private and National Forest System lands is the primary cause of reduced water quality. As previously discussed, a majority of the sedimentation is introduced into stream channels from soil disturbing activities such as roads, timber harvesting, off-highway vehicle use, and fire lines (Swank et al. 1989). Sediment is an appropriate measure to determine the effects of management activities on water quality and its associated beneficial uses on forested lands (Coats and Miller 1981). Sediment increases can adversely affect aquatic species productivity and diversity, degrade drinking water, and affect recreational values.

To evaluate the alternatives, the Forest’s four Management Areas were divided into 49 administrative watersheds (Figure 3 - 1). The size of these watersheds ranges from 5,316 to 155,398 acres and are modified USGS 5th level hydrologic units. The average watershed size used in this analysis is approximately 51,300 acres. The cumulative effects for each alternative on all 49 watersheds were evaluated separately.

As discussed in the Soil and Water Affected Environment section, stream sedimentation numbers were estimated using the Forest Service Southern Region Watershed Condition Rank procedure. For each alternative, the total stream sedimentation numbers represent an estimate of erosion that would reach the stream network from private as well as Forest Service activities (Table 3 - 9). These sedimentation numbers have been estimated for the next five decades. Since the results for each decade are very similar, only the first decade has been reported in this Draft Environmental Impact Statement.

Due to natural variability, geography, climatic conditions, and some of the assumptions on which stream sediment values are based, it is important to view these numbers as comparative rather than absolute values. Most stream sedimentation occurs in the first three years after a soil disturbing activity.

Table 3 - 9. Percent Sediment Increase above existing conditions due to Private and Forest Service Activities.

Map Number (Figure 3 - 2)	HUC	A	B1	C	C1	D	E1
2	5100101130	1.02	0.16	0.76	0.76	0.76	0.78
3	5100101100	1.26	0.14	0.97	0.97	0.97	0.98
4	5100101040	1.70	0.18	1.29	1.35	1.38	1.40
5	5100101140	1.25	0.12	1.00	1.00	1.00	1.00
6	5100101110	1.56	0.17	1.23	1.23	1.23	1.24
7	5100101090	0.23	0.03	0.19	0.19	0.19	0.18
8	5100204120	0.94	0.18	0.84	0.84	0.84	0.77
9	5100204170	0.41	0.08	0.46	0.46	0.46	0.42
10	5100204140	0.76	0.14	0.81	0.81	0.81	0.75
11	5100204060	0.56	0.13	0.63	0.63	0.63	0.59
12	5100204040	0.47	0.09	0.46	0.46	0.46	0.43
13	5100204030	0.42	0.09	0.41	0.41	0.41	0.38
14	5100204050	2.07	0.35	2.28	2.28	2.28	2.14
15	5100204070	0.11	0.02	0.12	0.12	0.12	0.11
16	5100204010	0.17	0.04	0.15	0.15	0.15	0.14
17	5100204020	0.83	0.20	0.99	0.99	0.99	0.94
18	5130102060	0.50	0.09	0.75	0.75	0.75	0.78
19	5130102050	3.08	0.24	4.67	4.67	4.67	4.85
20	5130102030	4.37	0.32	6.85	6.85	6.85	7.08
21	5100203020	0.81	0.17	0.57	0.57	0.57	0.59
22	5100203050	0.38	0.08	0.26	0.26	0.26	0.27
23	5130102040	0.50	0.11	0.70	0.70	0.70	0.73
24	5130102080	0.44	0.04	0.61	0.61	0.61	0.64
25	5100202030	1.23	0.24	0.78	0.78	0.78	0.82
26	5100203030	2.08	0.38	1.26	1.26	1.26	1.31
27	5100203040	0.73	0.16	0.54	0.54	0.54	0.56
28	5100203010	4.40	0.87	3.39	3.44	3.50	3.61
29	5130102070	5.07	0.37	8.06	7.98	7.98	8.26
30	5100202020	0.00	0.00	0.00	0.00	0.00	0.00
31	5100202010	0.33	0.07	0.22	0.22	0.22	0.23
32	5130102090	2.14	0.20	3.38	3.38	3.38	3.46
33	5130103040	1.48	0.12	2.38	2.38	2.38	2.43
34	5130102100	16.49	1.32	26.00	26.00	26.00	26.34
35	5130101450	1.99	0.22	3.17	3.17	3.17	3.25
36	5130103010	8.09	0.61	12.56	13.14	13.43	13.81
37	5130101370	6.57	0.50	10.42	10.38	10.38	10.71
38	5130104250	4.26	0.33	6.50	6.42	6.42	6.70
39	5130103020	12.75	0.97	20.72	20.72	20.72	20.96
40	5130101440	4.69	0.43	7.29	7.29	7.29	7.29
41	5130101430	9.36	0.75	14.78	14.78	14.78	15.11
42	5130104310	0.68	0.07	1.04	1.04	1.04	1.08
43	5130101410	2.17	0.19	3.42	3.42	3.42	3.52
44	5130101420	2.64	0.28	4.06	4.06	4.06	4.13
45	5130101400	2.29	0.24	2.95	2.95	2.95	3.20
46	5130104290	7.80	0.59	12.11	12.11	12.11	12.53
47	5130104270	0.24	0.06	0.35	0.35	0.35	0.35
48	5130101360	0.48	0.06	0.44	0.44	0.44	0.51
49	5130101350	0.16	0.07	0.16	0.16	0.16	0.17
50	5100201230	0.02	0.02	0.02	0.02	0.02	0.02

Water Quality

As discussed in the Affected Environment portion of the Soil and Water section, erosion and stream sedimentation are the major water quality problems on the Forest and will be discussed for each alternative. However, other pollutants are causing serious impacts in several watersheds such as those associated with mineral extraction, sewage discharge, and agricultural run off. These activities occur mostly on private lands, however. None of the proposed activities for National Forest System land would alter overall water quality to a great extent, but some localized impacts could occur. While private activities affecting water quality may change in the next decade, the location, severity, and timing of these actions are difficult to project.

The miles of user-developed off-highway vehicle (OHV) trails vary widely between watersheds and through time. Since 1998, numerous miles of OHV trails on National Forest System land have been closed. However, during this time total miles of user-developed trails per watershed decreased only slightly as new ones were created on both private as well as National Forest System land. Trail erosion can decrease water quality by generating stream sedimentation. These effects vary widely depending on access, current legal use, and population.

OTHER EFFECTS COMMON TO ALL ALTERNATIVES

Long-term Soil Productivity/Nutrient Cycling

Soil productivity is classified by the natural capability of the soil to sustain the growth of plants and plant communities over time. In addition, any measure of soil productivity must consider the maintenance of soil properties and qualities for protection of water quality and forest health. Since most Forest uses ultimately depend on productive soil, maintenance and enhancement of long-term soil productivity is a basic requirement of resource management on the DBNF.

Vegetation management practices, more specifically road building, invariably have the potential to degrade soil quality and health, impairing the soil’s capacity to perform its functions of sustaining plant and animal (including soil microflora and microfauna) productivity. In addition, forest health can be correlated with soil quality in regard to the incidence of various diseases (e.g., littleleaf disease, annosum root disease, and oak decline) and different invasive insect species (e.g., southern pine beetle, gypsy moth, and other bark beetles), affecting tree growth and mortality. Poor and/or damaged soils increase moisture stress and nutrient deficiencies, which in turn increase susceptibility to disease infections and invasive insect infestations (Briggs 1993). Studies indicate that nutrient losses from timber harvests can be comparable to nutrient inputs, resulting in no long-term reduction of the ecosystem’s productive potential (Kimmins 1977; Wells and Jorgensen 1978; Patric 1980; Grier et al. 1989). Nutrient losses from timber harvest were found to be small to negligible since such losses are a small fraction of the total nutrient capital, site productivity would not be reduced (Sopper 1975).

Demands on the soil potentially exceed the natural nutrient supplying capacity of the system only where timber harvest is coupled with mechanical piling or windrowing of slash and all other woody and organic material on the forest floor. Even then, the quantitative effects of this more intensive treatment on the biological, chemical, and physical processes in the soil are not sufficiently known to fully predict the long-term impact on soil productivity. Measurement of statistically significant treatment differences is complicated by wide variation in forest soil nutrient levels (Miller and Sirois 1986).

Timber harvest can release nutrients bound in the soil and biomass by increasing soil temperature as well as the amount of light and water available to the forest floor. These factors all accelerate decomposition of organic matter along with the organic constituents included in the residual logging slash. As organic matter levels rise, soil microorganisms play an instrumental role in the conversion to humus, a relatively stable form of carbon sequestered in soils for long periods (decades and even centuries). Soils in the proposed treatment areas in all alternatives are capable of retaining released nutrients rather than losing them through drainage or volatilization.

In contrast to the potential effects of logging on productivity and nutrient cycling, fallen trees, windblown or killed by insects or disease, would improve local soil productivity over the long-term if left in place. Tree decay enriches nutrient capital, enhancing many biological processes and physical attributes important for soil development and management.

Predicting the Forestwide effects of various disturbance activities on soil productivity is complicated by many factors. These include the spatial and temporal variability of soil properties and qualities as well as site-specific conditions (e.g., slope steepness, landform position, soil depth, soil textures), weather, and intensity of various disturbances. Instead of calculating a statistical probability of change, the art and science of forest management can predict the potential effects of proposed management activities on soil productivity only in general terms.

This effects analysis was limited to National Forest System lands. Only at the project level will potential effects from management of private lands be considered. In general, management of private lands has little direct or indirect influence on long-term soil productivity on National Forest System lands. In contrast, hydrologic responses (e.g., water quality, quantity and timing of streamflows, stream channel stability) are often linked directly with management activities on private lands. No cumulative effects to soils, therefore, are anticipated from implementation of the 2004 Forest Plan.

The application of Forestwide Standards and other resource protections limit the extent and duration of adverse environmental effects. Nevertheless, some adverse impacts to soils from management actions are unavoidable. These actions represent a commitment of soil resources necessary to support management as proposed in each alternative. Utilization of some acreage on the Forest is necessary to develop the infrastructure needed for sustainable production of goods and services as well as for restoration of lands damaged from mining, logging, etc., prior to their acquisition by the Forest Service. Careful planning and implementation of appropriate Standards can minimize most impacts to soil productivity. Under good stewardship, most adverse impacts should be low to moderate.

Many of the potentially affected acres would be dedicated to future use and management of the Forest over the long-term (i.e., ecosystem management). Projections of short- and long-term commitment of soils are shown in Table 3 - 10.

Table 3 - 10. Estimated short- and long-term soil impacts during the first decade of Plan implementation.

INDICATOR	ACRES BY ALTERNATIVE					
SHORT-TERM EFFECTS	**A**	**B-1**	**C**	**C-1**	**D**	**E-1**
Vegetation management	4,200	1,602	4,203	4,203	4,203	4,255
Prescribed fire	4,130	770	6,364	6,364	6,364	770
Fire lines	233	30	233	233	233	80
Total short-term soil impacts	8,563	2,402	10,800	10,800	10,800	5,105
Percent of Forest with short-term soil impacts	1.3%	0.4%	1.6%	1.6%	1.6%	0.8%
LONG-TERM EFFECTS	**A**	**B-1**	**C**	**C-1**	**D**	**E-1**
Classified roads	430	106	675	675	675	806
Temporary roads	107	26	169	169	169	202
Timber harvest	5,224	1,535	7,375	7,375	7,375	8,870
Developed recreation	555	555	555	555	555	555
Motorized & non-motorized trails	363	204	363	408	451	451
Administrative & communication sites	40	40	40	40	40	40
Oil and gas development	76	42	90	90	90	118
Other mineral development	529	529	529	529	529	529
Total long-term soil impacts	7,324	3,037	9,796	9,841	9,884	11,571
Percent of Forest with long-term soil impacts	1%	0.4%	1.4%	1.4%	1.4%	1.7%
TOTALS						
Total soil impacts	15,887	5,439	20,596	20,641	20,684	16,676
Total short-term soil impacts	8,563	2,402	10,800	10,800	10,800	5,105
Total long-term soil impacts	7,324	3,037	9,796	9,841	9,884	11,571
Percent of Forest with soil impacts	2.3%	0.8%	3.0%	3.0%	3.0%	2.4%

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Erosion and Sedimentation

Accelerated erosion is an unavoidable consequence of such management activities as road construction, timber harvest, and to a lesser degree, recreational uses such as off-highway vehicle trails and heavily used dispersed camping sites.

The soil disturbances that would result from implementation of Alternative A could increased the risk of accelerated erosion and sedimentation rates on 11,345 acres of National Forest System land during the first decade of the 2004 Forest Plan.

Soil Displacement

Removal of surface soil layers, rich in nutrients as well as numbers and diversity of soil microorganisms, can have a strong adverse influence on soil productivity. Under Alternative A, about 7,215 acres would be subject to some level of soil displacement.

Soil Compaction

Soil compaction results in soil conditions less favorable for plant growth. With repeated passage of heavy equipment, off-highway vehicles, and foot traffic, soil compaction can occur on all soils developing on the forest. The area disturbed and compacted increases with each succeeding harvest entry, commercial thinning, and final harvest followed by mechanical site preparation.

Over the first 10 years of the 2004 Forest Plan, compaction generated by operation of heavy machinery while harvesting timber, doing mechanical site preparation, construction of roads, drill pads, fire lines, etc., would likely have an adverse effect on about 13,930 acres.

Fire

The effects of prescribed fire on soil productivity can vary with soil conditions (e.g., antecedent soil moisture), soil properties, and qualities, as well as the type, extent, intensity, and duration of the burn plus fuel loads and conditions. Where fire is of such duration and intensity that it affects soil biota, structure, organic matter, and fertility, it may potentially trigger accelerated erosion and loss of soil nutrients. Suspended solids, sediments, and dissolved salts in streamflow would increase nutrient enrichment.

This analysis presumes that three percent of the acreage treated with prescribed burning would likely be burned severely, therefore, as many as 4,130 could be affected. A severe burn consumes organic matter on surface and within the upper half-inch of the mineral soil, visibly altering soil structure and/or color. Hydrologic condition and function of soils and their productive potential also are harmed in the short-term.

Slope Stability

When soils are displaced and/or buried from slope failures, natural or human caused, the original site becomes less productive. Removal of tree cover from soils can accelerate the occurrence of landslides due to loss of root strength in soils prone to failure. Furthermore, changes in infiltration and permeability rates associated with timber harvest and road building affect soil stability.

Relative slope stability risks, at the Forestwide scale for Alternative A, are projected to be about 12.5 percent. These risks were based on calculated factor-of-safety values, supplemented with recorded and general field observations over time as to the tendency of individual soils to slide or slump both naturally and where disturbed by various management actions. The most accurate scrutiny, evaluation, and estimation of stability risks occur only at the project-level scale.

The relative risk ratings used to derive this conclusion are Low, less than 10 percent risk; Moderate or Medium, 10-30 percent risk; and Severe, greater than a 30 percent risk. This represents a ratio of acres proposed for vegetation management to acres recognized as having higher stability risks. These values are considered “incremental risk” associated with projected vegetation management and road construction activities in support of each alternative. This is in addition to background risks that may exist with slope stability independently of implementation of each alternative or absence of land management activities.

Water Quantity/Water Use

The effects of changes in water yield by Management Area for Alternative A are shown in Table 3 - 11. The difference in water yields is expressed as the percent of increase over natural yields and range from 0.23 to 0.86 percent. Water yield varies widely by time of year, intensity, and duration of storms, antecedent moisture conditions, as well as the timing of concentration of contributing flows. Water yield increases similar to those in Alternative A, less than two percent, would probably go undetected. Localized increases could be larger than those reported in Table 3 - 11, but such effects would be more appropriately addressed at the project level.

Based on local knowledge and field observations, stream channels within the DBNF are usually stable and capable of handling the small increases in flow projected for this alternative without causing channel erosion. This is particularly true of water yield increases that occur during summer low-flow periods. Table 3 - 11 also shows how the projected increases in water yield for Alternative A compares with the 1995 water use data by Management Area. As the table shows, the projected increases are relatively small (< 5 mg/d). In any case, supply far exceeds demand on most occasions. Any increases in summer low-flow, if detectible, would benefit local water users and instream uses. However, any action under this alternative would likely have little effect on local water supplies or aquatic biota.

Table 3 - 11. Water yield and water use increases by Management Area for Alternative A.

MANAGEMENT AREA	% Water Yield Increase	Water Yield Increase (millions of gallons per day)	Total Water Use (millions of gallons per day)
Licking River	0.43	2.08	37.11
Middle Kentucky River	0.23	1.10	15.86
Upper Kentucky River	0.36	1.77	7.92
Upper Cumberland River	0.86	4.19	424.31

CUMULATIVE EFFECTS

Erosion and Sedimentation

As shown in Figure 3 - 3, the projected increase in stream sediment from erosion on both private and National Forest System lands would range from 0.02 to 16.49 percent. Given the natural variability of stream sedimentation, even cumulative changes within this range should be negligible on a 5th level watershed scale and should not change the Watershed Condition Rank for any of the watersheds. The Analysis revealed that 25 watersheds are in Excellent condition and three are in Average condition.

The risk of increased cumulative effects from erosion on National Forest System lands should remain low. Implementation of appropriate Standards should minimize soil loss, safeguarding long-term soil productivity and water quality. Successful revegetation of disturbed soils, normally achieved within two or three growing seasons, can return erosion rates to pre-disturbance levels.

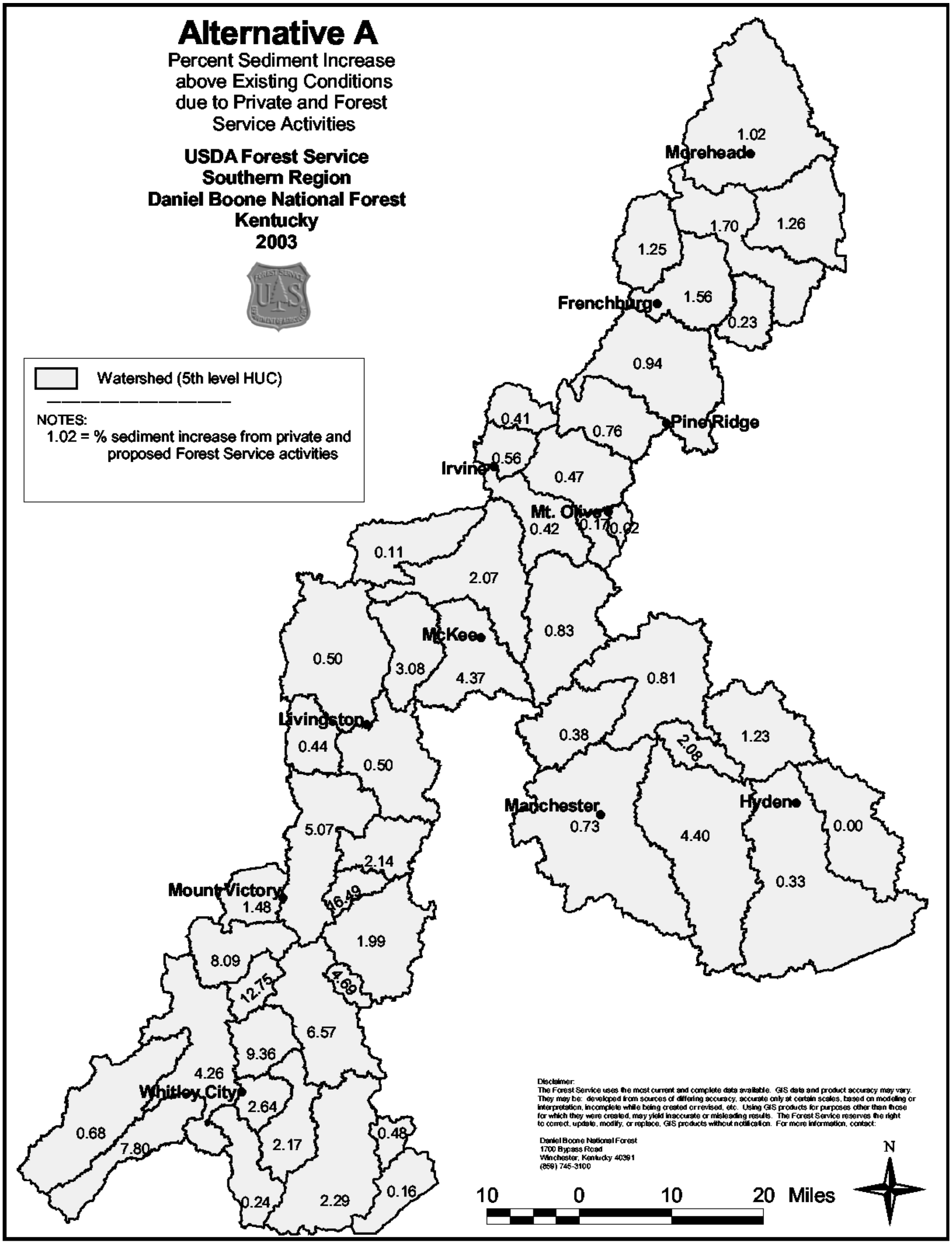

Figure 3 - 3. Cumulative stream sediment increases by watershed.

OTHER EFFECTS

Long-term Soil Productivity/Nutrient Cycling

Implementation of Alternative A and its potential effects on soil resources, excluding roads, which are dedicated to long-term use and Forest management, would have a moderate effect on long-term soil productivity. Long-term effects would impact approximately 7,324 acres, or about one percent of National Forest System lands. The productive potential of affected soils would likely be reduced by 5 to 15 percent.

Many impacts to soils are unavoidable. Utilization of some acreage is necessary to develop the infrastructure, such as roads, needed for sustainable production of goods and services from the Forest.

In general, soil productivity across the Forest is judged to be stable or improving. Only localized declines in soil productivity are taking place. Those declines are due to soils lost or displaced by erosion as well as soils moved or compacted during the construction of roads, log landings, or drilling pads/pits, etc. While such uses have increased soil loss and soil resource commitment Forestwide, the overall impact remains low.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Erosion and Sedimentation

Accelerated erosion is an unavoidable consequence of many forest management activities such as road construction, timber harvest, and, to a lesser degree, recreational uses such as off-highway vehicle trails and heavily used dispersed camping sites.

Implementation of various management prescriptions is projected to generate an increased risk of accelerating erosion and sedimentation rates on 2,933 acres for the first decade of the 2004 Forest Plan.

Soil Displacement

Removal of surface soil layers, rich in nutrients as well as the number and diversity of soil microorganisms, can adversely influence soil productivity to a great degree. Under Alternative B-1, an estimated 2,829 acres would be subject to some amount of surface soil displacement.

Soil Compaction

Soil compaction results in less than favorable conditions for plant growth. Repeated passage of heavy equipment, excessive use of off-highway vehicles, and even foot traffic, can cause compaction of any soil on the DBNF. Each succeeding harvest entry, commercial thinning, or final harvest followed by mechanical site preparation, can disturb or compact a wider area.

Over the first 10 years of the 2004 Forest Plan, compaction generated by operation of heavy machinery while harvesting timber, doing mechanical site preparation, construction of roads, drill pads, fire lines, etc., would likely have an adverse effect on about 3,711 acres.

Fire

The effects of prescribed fire on soil productivity can vary with soil conditions (e.g., antecedent soil moisture), soil properties and qualities, as well as the type, extent, intensity, and duration of the burn plus fuel loads and conditions. Where fire is of such duration and intensity that it affects soil biota, structure, organic matter, and fertility, it may trigger accelerated erosion and loss of soil nutrients. Suspended solids, sediments, and dissolved salts in streamflow would increase nutrient enrichment.

An estimated three percent of all acres burned by prescribed fire are likely to be burned severely. A severe burn consumes all organic matter on the soil surface and within the upper half-inch of the mineral soil, visibly altering soil structure and/or color. Additionally, the hydrologic condition and function of severely burned soils, as well as their productive potential, are harmed in the short-term. Under Alternative B-1 as many as 770 acres would likely be burned severely by prescribed fire.

Slope Stability

When soils are displaced or buried by slope failures, the original site becomes less productive. Removal of tree cover and the loss of root strength in soils prone to failure can accelerate the occurrence of landslides. In addition, changes in infiltration rates and permeability associated with timber harvest and road building affect soil stability.

The relative slope stability risk at the Forestwide level for Alternative B-1 is projected to be about one-half of one percent. This was calculated using factor-of-safety values supplemented by field observations over time as to the tendency of individual soils to slide or slump naturally or when disturbed by various management activities. It represents a ratio of acres proposed for vegetation management to acres recognized as having higher stability risks. These values are based on the "incremental risk" associated with projected vegetation management and road construction activities in support of an alternative. This is in addition to the background risk that may exist, the alternative implemented, or the land management activities conducted. A relative risk of less than 10 percent is rated as Low, 10-30 percent is Moderate or Medium, and greater than 30 percent is Severe. The most accurate scrutiny, evaluation, and estimation of stability risks can be made only at the project level, however.

Water Quantity/Water Use

The effects of changes in water yield for Alternative B-1 are shown in Table 3 - 12. These water yields are expressed as the percentage increase over natural water yields and range from 0.09 to 0.24 percent. Water yield varies widely by time of year, intensity, and duration of storms, antecedent moisture conditions, as well as the timing of concentration of contributing flows. Water yield increases similar to those in Alternative B-1, less than two percent, would probably go undetected. Localized increases could be larger than those reported in Table 3 - 12, but such effects would be more appropriately addressed at the site-specific project level.

Based on local knowledge and field observations, stream channels within the Forest are usually stable and capable of handling the small increases in flow that are projected for this alternative without causing channel erosion. This is particularly true if the increases in water yield occur during summer low-flow periods.

Table 3 - 12 also shows how the projected increases in water yield for Alternative B-1 compares with the 1995 water use data by Management Area. As the table shows, the projected increases are relatively small (< 2 mg/d), especially considering that supply far exceeds demand on most occasions. Any increases in summer low-flow, if detectible, would be a benefit to local water users and instream uses. However, it is unlikely that actions in this alternative would have an effect on local water supplies or aquatic biota.

Table 3 - 12. Water yield and water use increases by Management Area for Alternative B-1.

MANAGEMENT AREA	% Water Yield Increase	Water Yield Increase (millions of gallons per day)	Total Water Use (millions of gallons per day)
Licking River	0.09	0.42	37.11
Middle Kentucky River	0.09	0.44	15.86
Upper Kentucky River	0.09	0.45	7.92
Upper Cumberland River	0.24	1.16	424.31

CUMULATIVE EFFECTS

Erosion and Sedimentation

As shown in Figure 3 - 4, the percentage of stream sediment increase above existing conditions from erosion of both private and National Forest System land would range from 0.02 to 1.32 percent. Given the natural variability associated with stream sedimentation, cumulative changes of this magnitude would likely go undetected on a 5th level watershed and would not change the Watershed Condition Rank for any of the watersheds. The Analysis revealed that 25 watersheds are in Excellent condition, two are in Average condition.

The risk of additional cumulative effects associated with erosion from National Forest System lands would be low. Implementation of appropriate management Standards would serve to minimize soil loss as well as safeguard long-term soil productivity and water quality. Successful revegetation of disturbed soils can be achieved within two or three growing seasons, returning erosion rates to pre-disturbance levels.

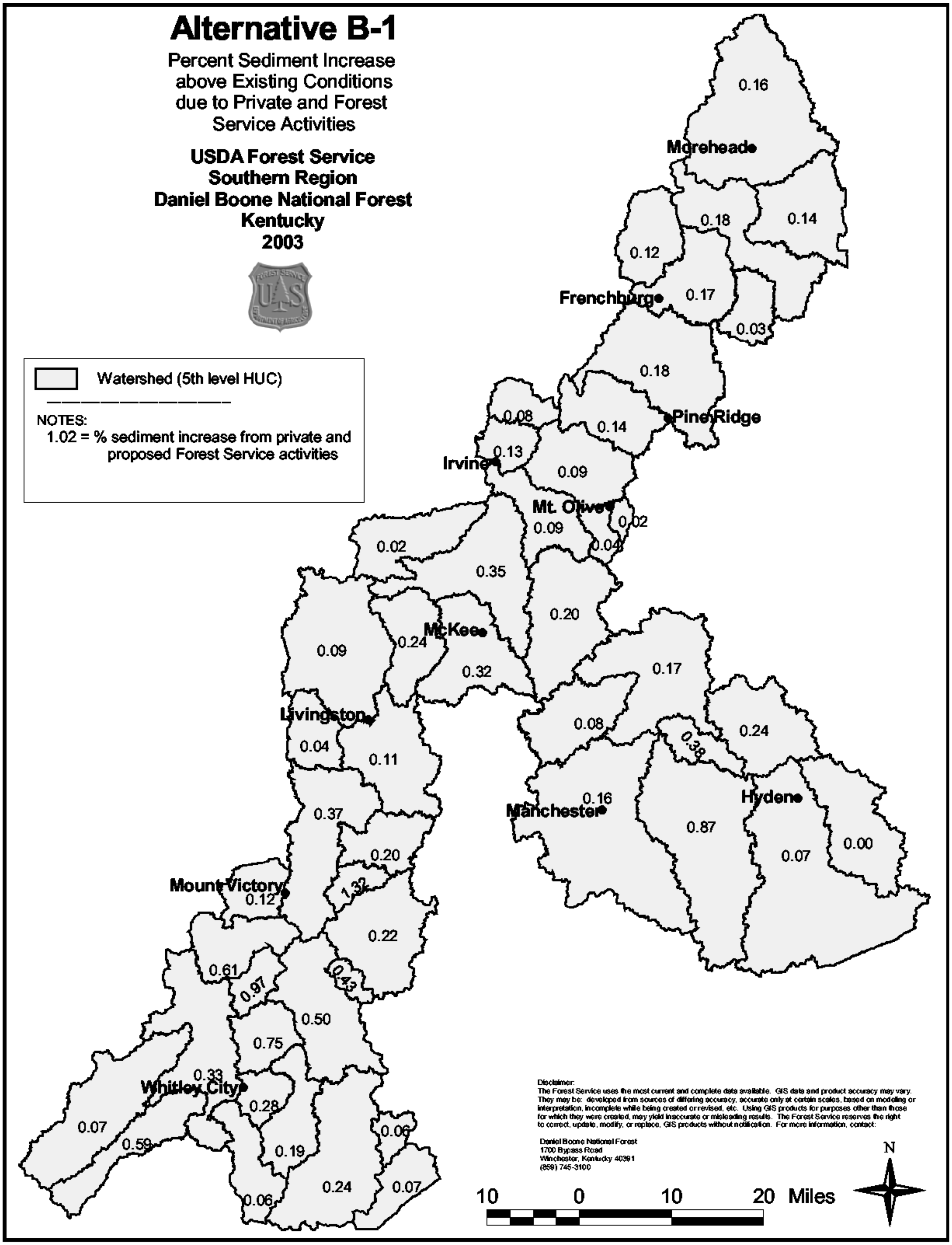

Figure 3 - 4. Cumulative stream sediment increases by watershed.

OTHER EFFECTS

Long-term Soil Productivity/Nutrient Cycling

Based on analysis of proposed management and its potential effects on the soils resource, implementation of Alternative B-1, excluding roads, which are dedicated to long-term use and Forest management, would have a small effect on long-term soil productivity. The resulting loss in productive potential would be less than five percent. Many of the projected impacts to soils are unavoidable, however. They represent a commitment of soil resources necessary to support proposed Forest management goals. Utilization of some acreage is necessary to develop the infrastructure needed for sustainable production of goods and services.

In general, soil productivity across the DBNF ranges from stable to improving. Only localized declines in soil productivity are occurring. Erosion, displacement, and compaction caused by construction of roads, log landings, drilling pads/pits, etc., are responsible for most decreases in soil productivity on the forest. Overall, these reductions are low. Total estimated long-term soil impacts of 3,037 acres or about 0.4 of one percent of the Forest has been predicted as occurring under Alternative B-1 in the first decade.

ALTERNATIVES C, C-1, AND D

DIRECT AND INDIRECT EFFECTS

Erosion and Sedimentation

Accelerated erosion is an unavoidable consequence of road construction, timber harvest, and to a lesser degree, recreational uses such as off-highway vehicle trails and heavily used dispersed camping sites.

Implementing the mix of management prescriptions in the 1985 Plan that disturbs soils would likely accelerate erosion and sedimentation rates. These three alternatives would cause about the same level of soil disturbance, based on the acreage planned for vegetation management, site preparation, prescribed fire, blade constructed fire lines, recreation trails and road construction. Alternatives C, C-1, and D would create elevated erosion potential on 13,305, 13,340 and 13,375 acres, respectively, for the first decade of the 2004 Forest Plan.

Soil Displacement

Removal of surface soil layers, rich in nutrients as well as the numbers and diversity of soil microorganisms, can have a strong adverse influence on soil productivity. Under Alternatives C, C-1, and D they would subject an estimated 6,947 acres to some level of soil displacement.

Soil Compaction

Soil compaction results in soil conditions less favorable for plant growth. Soil compaction can occur on all of the soils developing on the forest with repeated passage of heavy equipment, OHVs and foot traffic. The area disturbed and compacted increases with each succeeding harvest entry, commercial thinning, and final harvest followed by mechanical site preparation.

Over the first 10 years of the 2004 Forest Plan, compaction generated by operation of heavy machinery while harvesting timber, doing mechanical site preparation, construction of roads, drill pads, fire lines, etc., would likely have an adverse effect on about 9,990 acres.

Fire

The effects of prescribed fire on soil productivity can vary with soil conditions (e.g., antecedent soil moisture), soil properties and qualities, as well as the type, extent, intensity, and duration of the burn plus fuel loads and conditions. Where fire is of such duration and intensity that it affects soil biota, structure, organic matter, and fertility, it may potentially trigger accelerated erosion and loss of soil nutrients. Suspended solids, sediments and dissolved salts in streamflow would increase nutrient enrichment.

An estimated two percent of all acres burned using prescribed fire would be severely burned. A severe burn consumes all organic matter on the soil surface and within the upper half-inch of the mineral soil, visibly altering soil structure and/or color. Hydrologic condition and function of soils and their productive potential are harmed in the short-term.

Of the acreage likely to be treated with prescribed fire during the first decade, only about 6,364 acres would be severely affected.

Slope Stability

When soils are displaced and/or buried from slope failures, natural or human caused, the original site becomes less productive. Removal of tree cover from soils can accelerate the occurrence of landslides due to loss of root strength in soils prone to failure. Furthermore, changes in infiltration and permeability rates associated with timber harvest and road building affect soil stability.

Relative slope stability risks, at the Forestwide scale for Alternatives C, C-1, and D are projected to be 6.3 percent. These risks were based on calculated factor-of-safety values, supplemented with recorded and general field observations over time as to the tendency of individual soils to slide or slump both naturally and where disturbed by various management actions. The most accurate scrutiny, evaluation, and estimation of stability risks occur only at the project-level scale.

The relative risk ratings used to derive this conclusion are Low, less than 10 percent risk; Moderate or Medium, 10-30 percent risk; and Severe, greater than a 30 percent risk. This represents a ratio of acres proposed for vegetation management to acres recognized as having higher stability risks. These values are considered “incremental risk” associated with projected vegetation management and road construction activities in support of each alternative. This is in addition to background risks that may exist with slope stability independently of implementation of each alternative or absence of land management activities.

Water Quantity/Water Use

The effects of the changes in water yield for Alternatives C, C-1, and D are shown in Table 3 - 13. The water yields are expressed as the percentage of increase over natural water yields and range from 0.45 to 1.36 percent. Water yield is extremely variable in the relation to the time of year, intensity, and duration of storms, antecedent moisture conditions, as well as the timing of concentration of contributing flows. Water yield increases similar to those in Alternatives C, C-1 and

D of less than two percent would probably go undetected. Localized increases could be larger than those reported in Table 3 - 13. These effects are more appropriately addressed at the site-specific project level.

Based on local knowledge and field observations, stream channels within the Forest are usually stable and capable of handling the small increases in flow that are projected for these alternative without causing channel erosion. This is particularly true if the increases in water yield occur during summer low-flow periods.

Table 3 - 13 also shows how the projected increases in water yield for Alternatives C, C-1 and D compares with the 1995 water use data by Management Area. As the table shows the projected increases are relatively small (< 7 mg/d) especially considering supply far exceeds demand on most occasions. Any increases in summer low-flow, if detectible, would be a benefit to local water users as well as instream uses. However, it is unlikely that actions in these alternatives would have an effect on local water supplies or aquatic biota.

Table 3 - 13. Water yield and water use increases by Management Area for Alternatives C, C-1, and D.

MANAGEMENT AREA	% Water Yield Increase	Water Yield Increase (millions of gallons per day)	Total Water Use (millions of gallons per day)
Licking River	0.09	2.81	37.11
Middle Kentucky River	0.09	2.20	15.86
Upper Kentucky River	0.09	3.57	7.92
Upper Cumberland River	0.24	6.66	424.31

CUMULATIVE EFFECTS

Erosion and Sedimentation

Figure 3 - 5 shows that the percentage of stream sediment increase above existing conditions from the combination of private and Forest Service erosion ranges from 0.02 to 26.00 percent. Given the natural variability associated with stream sedimentation, it is unlikely that cumulative changes of this magnitude will be detectable on a 5th level watershed scale or will change the Watershed Condition Rank for any of the watersheds. The Analysis revealed that 25 watersheds are in Excellent condition, two are in Average condition.

On Forest Service System lands there is a low risk of adding to the cumulative effects associated with erosion processes. Implementation of appropriate mitigating measures or management standards would serve to minimize soil loss rates as necessary to safeguard long-term soil productivity and water quality. Successful revegetation of disturbed soils normally is achieved within two or three growing seasons, thereby returning erosion rates to pre-disturbance levels.

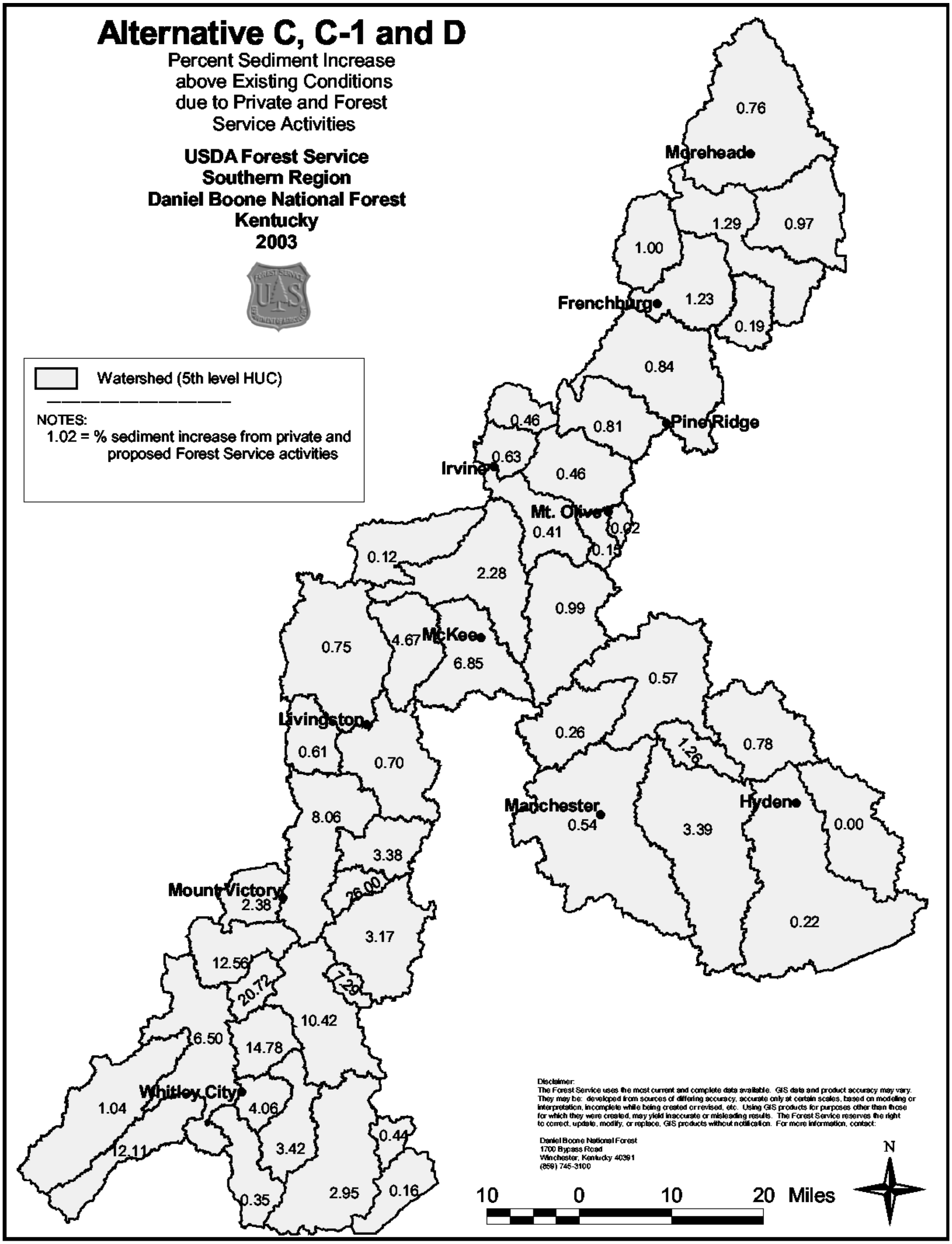

Figure 3 - 5. Cumulative stream sediment increases by watershed.

OTHER EFFECTS

Long-term Soil Productivity/Nutrient Cycling

Soil productivity is the natural capability of the soil to sustain the growth of plants and plant communities over time. In addition, this includes maintenance of soil properties and qualities for protection of water quality and forest health as well. Therefore, since most Forest uses ultimately depend on a productive soil resource, maintenance and enhancement of long-term soil productivity is a basic requirement of Forest management.

Based on analysis of proposed management and potential effects on the soils resource, implementation of alternatives C, C-1, or D (excluding roads, which are dedicated to long-term use and management of the forest) would have a moderate effect on long-term productivity, resulting in a 5 to 15 percent reduction in productive potential. Many of the projected impacts to soils are unavoidable, however. They represent a commitment of soil resources necessary to support proposed Forest management goals. Utilization of some acreage is necessary to develop the infrastructure needed for sustainable production of goods and services from the Forest.

In general, soil productivity across the forest is judged to be stable to improving. Essentially, only localized declines in soil productivity are occurring. These losses are directly associated with erosion, soil displacement, and increases in soil density from compaction, caused by construction of roads, log landings, drilling pads/pits, etc. Overall, these reductions are low across the forest.

Total estimated long-term soil impacts for Alternatives C, C-1, and D are 9,796; 9,841; and 9,884 acres respectively or about 1.4 percent of the Forest within the first decade.

ALTERNATIVE E-1

Direct and Indirect Effects Erosion and Sedimentation

Accelerated erosion is an unavoidable consequence of road construction, timber harvest, and to a lesser degree, recreational uses such as off-highway vehicle trails and heavily used dispersed camping sites.

Implementing the mix of management prescriptions in the 1985 Plan that would disturb soils, is projected to generate an increased risk of accelerating erosion and sedimentation rates on 30,543 acres for the first decade of the 2004 Forest Plan.

Soil Displacement

Removal of surface soil layers, rich in nutrients and numbers and diversity of soil microorganisms, can have a strong adverse influence on soil productivity. Under Alternative E-1 an estimated 8,285 acres would be subject to some level of soil displacement in the first decade.

Soil Compaction

Soil compaction results in soil conditions less favorable for plant growth. Soil compaction can occur on all of the soils developing on the forest with repeated passage of heavy equipment, OHVs and foot traffic. The area disturbed and compacted increases with each succeeding harvest entry, commercial thinning, and final harvest followed by mechanical site preparation.

Over the first 10 years of the 2004 Forest Plan, compaction generated by operation of heavy machinery while harvesting timber, doing mechanical site preparation, construction of roads, drill pads, fire lines, etc., would likely have an adverse effect on about 25,022 acres.

Fire

The effects of prescribed fire on soil productivity can vary with soil conditions (e.g., antecedent soil moisture), soil properties and qualities, as well as the type, extent, intensity, and duration of the burn plus fuel loads and conditions. Where fire is of such duration and intensity that it affects soil biota, structure, organic matter, and fertility, it may potentially trigger accelerated erosion and loss of soil nutrients. Suspended solids, sediments and dissolved salts in streamflow would increase nutrient enrichment.

For analysis purposes, a projected three percent of all acres burned using prescribed fire techniques would be severely burned. A severe burn consumes all organic matter on the soil surface and within the upper half-inch of the mineral soil, visibly altering soil structure and/or color. Hydrologic condition and function of soils and their productive potential are harmed in the short-term. The prescribed fire program under Alternative E-1 could potentially severely burn about 770 acres.

Slope Stability

When soils are displaced and/or buried from slope failures, natural or human caused, the original site becomes less productive. Removal of tree cover from soils can accelerate the occurrence of landslides due to loss of root strength in soils prone to failure. Furthermore, changes in infiltration and permeability rates associated with timber harvest and road building affect soil stability.

Relative slope stability risks, at the Forestwide scale for Alternative E-1 is projected to be 13.4 percent. These risks were based on calculated factor-of-safety values, supplemented with recorded and general field observations over time as to the tendency of individual soils to slide or slump naturally or when disturbed by various management actions. The most accurate scrutiny, evaluation, and estimation of stability risks occur only at the project-level scale.

The relative risk ratings used to derive this conclusion are Low, less than 10 percent risk; Moderate or Medium, 10-30 percent risk; and Severe, greater than a 30 percent risk. This represents a ratio of acres proposed for vegetation management to acres recognized as having higher stability risks. These values are considered “incremental risk” associated with projected vegetation management and road construction activities in support of each alternative. This is in addition to background risks that may exist with slope stability independently of implementation of each alternative or absence of land management activities.

Water Quantity/Water Use

The effects of the changes in water yield for Alternative E-1 are shown in Table 3 - 14. The water yields are expressed as the percentage of increase over natural water yields and range from 0.62 to 1.50 percent. Water yield is extremely variable in the relation to the time of year, intensity and duration of storms, antecedent moisture conditions, as well as the timing of concentration of contributing flows. Water yield increases similar to those in Alternative E-1 that are less than two percent would probably go undetected. Localized increases could be larger than those reported in Table 3 - 14. These effects are more appropriately addressed at the site-specific project level.

Based on local knowledge and field observations, stream channels within the Forest are usually stable and capable of handling the small increases in flow that are projected for this alternative without causing channel erosion. This is particularly true if the increases in water yield occur during summer low-flow periods.

Table 3 - 14 also shows how the projected increases in water yield for Alternative E-1 compare with the 1995 water use data by Management Area. As the table shows the projected increases are relatively small (< 8 mg/d) especially considering supply far exceeds demand on most occasions. Any increases in summer low-flow, if detectible, would be a benefit to local water users as well as instream uses. However, it is unlikely that actions in this alternative would have an effect on local water supplies or aquatic biota.

Table 3 - 14. Water yield and water use increases by Management Area for Alternative E-1.

Management Area	% Water Yield Increase	Water Yield Increase (millions of gallons per day)	Total Water Use (millions of gallons per day)
Licking River	0.81	3.95	37.11
Middle Kentucky River	0.62	3.03	15.86
Upper Kentucky River	0.83	4.06	7.92
Upper Cumberland River	1.50	7.34	424.31

CUMULATIVE EFFECTS

Erosion and Sedimentation

Figure 3 - 6 shows that the percentage of stream sediment increase from the combination of private and Forest Service erosion would range from 0.02 to 26.34 percent. Given the natural variability associated with stream sedimentation it is unlikely that cumulative changes of this magnitude will be detectable on a 5th level watershed scale or will change the Watershed Condition Rank for any of the watersheds. The Analysis revealed that 25 watersheds are in Excellent condition and three are in Average condition.

On Forest Service System lands there is a low risk of adding to the cumulative effects associated with erosion processes. Implementation of appropriate mitigating measures or management standards will serve to minimize soil loss rates as necessary to safeguard long-term soil productivity and water quality. Successful revegetation of disturbed soils normally is achieved within two or three growing seasons, thereby returning erosion rates to pre-disturbance levels.

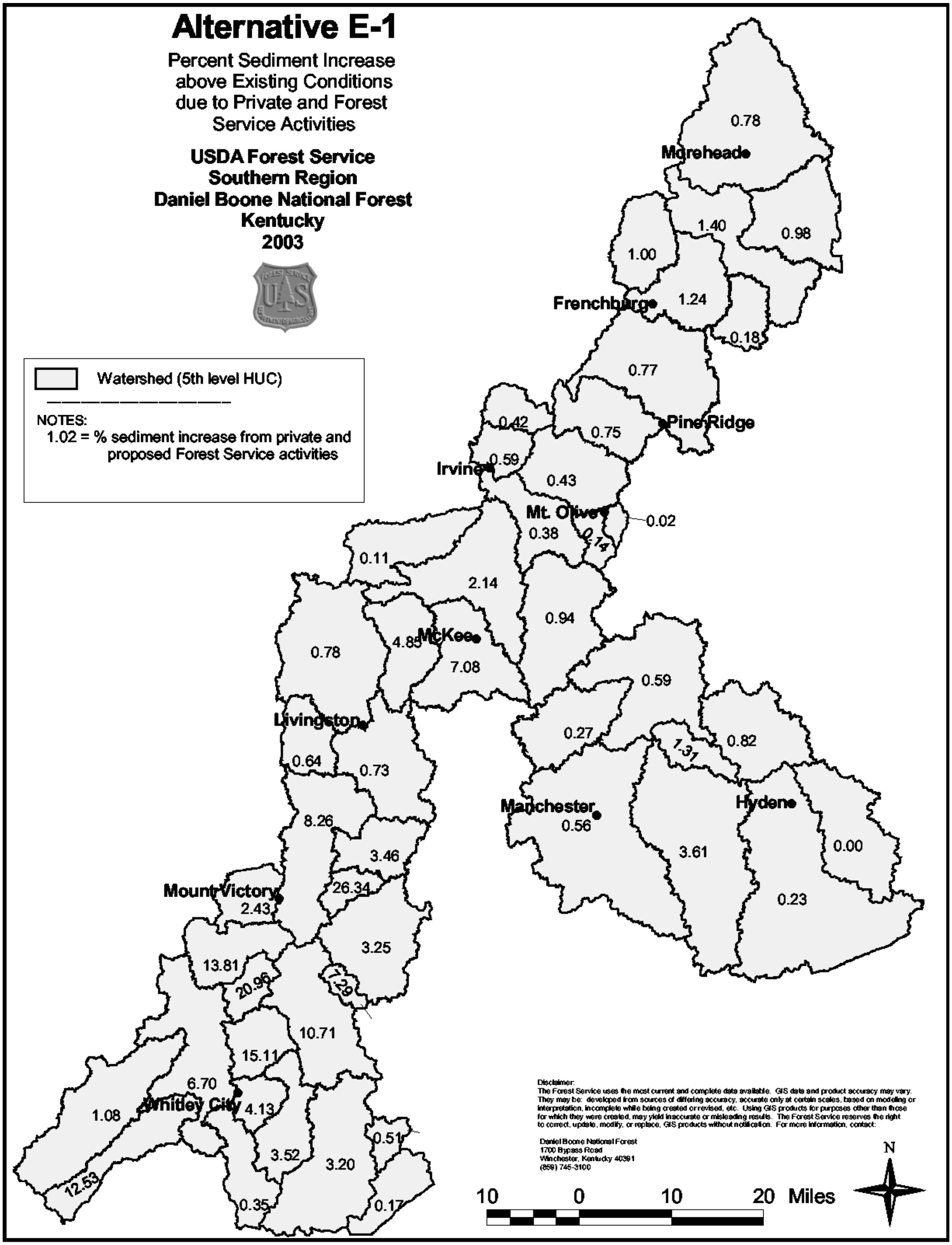

Figure 3 - 6. Cumulative stream sediment increases by watershed.

OTHER EFFECTS

Long-term Soil Productivity/Nutrient Cycling

Soil productivity is the natural capability of the soil to sustain the growth of plants and plant communities over time. In addition, this includes maintenance of soil properties and qualities for protection of water quality and forest health as well. Since most forest uses ultimately depend on a productive soil resource, maintenance and enhancement of long-term soil productivity is a basic requirement of Forest management.

Based on analysis of proposed management and potential effects on the soils resource, implementation of Alternative E-1, excluding roads, which are dedicated to long-term use and management of the Forest will have a moderate effect on long-term productivity resulting in a 5 to 15 percent reduction in productive potential. Many of the projected impacts to soils are unavoidable. They represent a commitment of soil resources necessary to support proposed Forest management goals. Utilization of some acreage is necessary to develop the infrastructure needed for sustainable production of goods and services from the Forest.

In general, soil productivity across the forest is judged to be stable to improving. Essentially, only localized declines in soil productivity are occurring, where directly associated with increasing loss of soil from erosion, soil displacement, and increases in soil density from compaction, resulting from construction of roads, log landings, drilling pads/pits, etc., which all increase the amount of soil loss or total soil resource commitment. Overall, these reductions are low across the forest. Total estimated long-term soil impacts of about 11,571 acres, or about 1.7 percent of the Forest, has been predicted as occurring under Alternative E-1 in the first decade.

MINERALS

Affected Environment

BACKGROUND

Minerals are an important aspect of Kentucky's resources and contribute greatly to the local economy while helping meet both state and national energy needs. The Daniel Boone National Forest plays an important role in eastern Kentucky's mineral development as manager of 700,000 acres of National Forest System land. Minerals management differs significantly from management of other Forest resources such as timber or recreation opportunities.

First, minerals can be difficult to find and inventory. Secondly, development of mineral resources is very dependant on market conditions, local as well as national and global. Such uncertainties complicate out-year project planning. Still, the project planner must attempt to analyze the potential for development on available property and its potential environmental impacts. Development usually occurs near location of the resource. Determination of areas appropriate for mineral leasing must be made in light of such contingencies.

Also, the U.S. economy is very dependent on minerals, which are non-renewable resources. Mineral resources on the DBNF include limestone and building stone, petroleum, natural gas, and coal.

Legal and Administrative Framework

Statutory and regulatory direction separates mineral resources on federally owned lands into three categories: locatable, leasable, and salable. Statutes, regulations, and executive orders guide Forest Service policy governing the exploration and development of mineral resources on National Forest System lands.

Lands Statutorily Unavailable For Mineral Leasing or Permit

- Subject to valid existing rights, the minerals in lands designated under the Wilderness Act of 1964, are withdrawn from all forms of disposition under all laws pertaining to mineral leasing. The Daniel Boone National Forest has two congressionally designated wildernesses, the Clifty Wilderness on the Stanton Ranger District and the Beaver Creek Wilderness area on the Somerset Ranger District. In these areas, 17,437 acres are statutorily withdrawn from leasing. Currently, there are no issued federal mineral leases or permits within the Forest's two designated wilderness areas.
- Subject to valid existing rights, the minerals in federal lands, which constitute the bed or bank, or are situated within ¼ mile of the bank of any river designated a "Wild River" under this Wild and Scenic Rivers Act of 1968, are withdrawn from operation of the mineral leasing laws. This restriction does not apply to those segments of a Wild and Scenic River that are designated as "scenic" or "recreational."

Development along portions of two streams within the DBNF is subject to restrictions of the Wild and Scenic Rivers Act. The Red River was designated for inclusion in the Wild and Scenic River system in 1988, and a segment of Marsh Creek is eligible for designation. Most National Forest System land along the 4.1-mile stretch of the Red River classified as "wild" lies within the boundaries of the Clifty Wilderness. As such, it is already unavailable for lease under the Wilderness Act. Approximately 83.40 acres along the Red River that is subject to Wild and Scenic Rivers Act restrictions lie outside the wilderness boundary. These lands are statutorily withdrawn from mineral leasing under the Wild and Scenic Rivers Act. The 7-mile segment of Marsh Creek that is eligible for designation as a National Wild and Scenic River will be managed as a "wild" stream until a permanent determination is made.

Leasable Minerals

National Forest System lands are generally available for exploration and mining unless specifically precluded by an act of Congress or other formal withdrawal. Which mineral-leasing act applies depends on the type of lands and minerals involved. The 2004 Forest Plan identifies those areas, which are available and unavailable for energy and non-energy exploration and leasing. For non-energy leasable minerals, public scoping and a site-specific analysis are completed by the Forest Service upon BLM's receipt of a permit or lease application. This is done prior to issuance of the permit or lease. For energy leasable minerals, the 2004 Forest Plan makes both the land availability decision, and the decision to lease certain available federal minerals. Lands where the minerals are statutorily withdrawn from leasing are identified in the Forest Plan. Public scoping and site-specific analysis of energy leasable mineral development will be completed when a Notice of Staking (NOS), or an Application for Permit to Drill (APD), is received by the BLM and the Forest Service.

Leasable Minerals (Oil & Gas. Coal) – With passage of the 1920 Mineral Leasing Act, Congress established a program to provide for oil, gas and coal development on federal lands, including National Forests. This Act authorizes the Secretary of the Interior to issue leases for the disposal of certain minerals (including coal, phosphate, sodium, potassium, oil, oil shale, gilsonite, and gas). The Mineral Leasing Act for Acquired Lands of 1947 extends these mineral leasing provisions to acquired National Forest System lands but requires the consent of the Secretary of Agriculture prior to leasing. The purpose of this Act is "to promote the mining of coal, phosphate, sodium, potassium, oil, oil shale, gas, and sulphur on lands acquired by the United States." All National Forest System lands on the DBNF are "acquired." The Surface Mining Control and Reclamation Act of 1977 prohibits surface (strip) mining of coal on any federal lands within the boundaries of any National Forest east of the 100th meridian. Therefore, deposits of coal on the DBNF may be mined only by underground methods.

The Energy Security Act of 1980 directs the Secretary of Agriculture to process applications for leases and permits to explore, drill, and develop energy resources on National Forest System lands, notwithstanding the current status of any Land and Resource Management Plan (Forest Plan). Federal oil and gas leases on the DBNF since 1980 were issued in accordance with this congressional direction as well as public demand for energy resource development. The Act will also apply to 2004 Forest Plan. With passage of the Federal Onshore Oil and Gas Leasing Reform Act of 1987, Congress again recognized the Forest Service's role in the leasing and administration of surface operations during oil and gas development. The implementing regulations for this Act (36 CFR 22E) provide the basis for the analysis of alternatives and decisions on federal oil and gas leasing in the 2004 Forest Plan.

Executive Order 13212 (Actions to Expedite Energy-Related Projects) of 2001 states "executive departments and agencies shall take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy." The

Executive Order 13212 requires that: “For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections.”

The federal oil and gas leasing program on National Forests helps supply the nation with critical energy minerals and provides a source of revenue to local, state and federal governments. Oil and gas leases are issued primarily through a competitive bid process, generating revenue from bonus bids (not less than $2.00 per acre) as well as annual rental fees (not less than $1.50 per acre). If a producing well is drilled which produces oil and gas from lands covered by a federal lease, the federal government receives a 12.5 percent royalty based on actual production. In some instances, the normal 12.5 percent royalty could be higher. An increase in the royalty rate is a condition of re-instatement of a federal lease if rental was not paid in a timely manner. The royalty rate could be lower if the well meets the very narrow guidelines under the federal Royalty Reduction Act. The Dept. of Interior’s Minerals Management Service (MMS) collects all minerals revenues generated from federal leases. MMS then distributes 25 percent of mineral receipts acquired from leases on the DBNF to the state of Kentucky for allocation to the counties.

The 2004 Forest Plan makes two decisions related to minerals: 1) availability of lands for future leasing, and 2) consent to lease the available lands, subject to standard lease terms, or subject to additional constraints (stipulations) as required by a specific prescription area. The Forest Plan analyzes areas of the Forest with leasing interest or mineral potential using the “Reasonably Foreseeable Development Scenario” developed with the assistance of BLM geologists. This study looked at the long-term (10 years) potential for oil and gas development in the study area and projected the number of wells likely to be drilled during over 10 years. Under the 2004 Forest Plan, the BLM will be able to issue oil and gas leases in areas where the Plan makes both the availability and the consent decision. Because the availability and consent decisions are made in the Plan, environmental analysis and documentation for federal oil and gas is more detailed than for other leasable minerals.

Once an oil and gas lease is issued, the National Environmental Protection Act requires a second round of review before the lessee may stake the drill site, occupy the surface, or begin drilling. The Order outlines the necessary requirements for the approval of all proposed exploratory, development, and service wells. The lessee must apply to the BLM for an Application for Permit to Drill (APD) per direction in Onshore Oil and Gas Order #1. The APD contains two parts: the Surface Use Plan of Operations (SUPO), and the technical, “downhole” Drilling Plan. The Forest Service, in cooperation with the BLM, completes an environmental analysis, including public involvement, of the proposed roads, wells, and any other ground disturbance activities proposed in the SUPO portion of the APD. The BLM is responsible for the review and approval of the drilling plan. After the environmental analysis and public involvement, the Forest Service will decide whether to approve the surface use plan of operations portion of the APD. If the proposed location has been amended to accommodate other resource needs, the location must be approved. The specific Conditions of Approval (COA) must also be decided. The reclamation plan is critical part SUPO approval. Each operator proposing to develop federal minerals must post a bond with the BLM to insure compliance with operating and reclamation requirements.

Under the terms of a federal lease, the lessee is granted the exclusive right to drill for, mine, extract, remove, and dispose of all the leased resources, along with the right to build and maintain necessary improvements on the leasehold. Standard lease terms (SLTs) for federal oil and gas leases require operators to minimize adverse impacts to the land, air, and water as well as cultural, biological, visual, and other resources. STLs also require minimized adverse impact to other land uses or users. Federal environmental protection laws such as the Clean Air Act, Clean Water Act, Endangered Species Act, and Historic Preservation Act apply to all proposed activities.

In addition, based on prescription area direction in the Forest Plan, leases may be issued subject to stipulations that modify standard lease rights and are attached to and made a part of the lease. Conditions or restrictions in these stipulations are considered consistent with the lease rights granted, provided that they do not require relocation of proposed operations by more than 200 meters, require that the operations be sited off the leasehold, or prohibit new surface disturbing operations for a period in excess of 60 days in any lease year.

The three nationally approved stipulation forms include:

- No Surface Occupancy (NSO) – Used when surface occupancy of certain lands is prohibited.
- Timing / Season – Used to prohibit surface occupancy of certain lands during specific times, such as for protection during nesting or calving season.
- Controlled Surface Use (CSU) – Used when restrictions will apply to occupancy, such as requiring additional mitigation to resolve potential conflicting uses, or to meet visual quality objectives.

A lease may also be issued subject to a lease notice (LN). A notice does not contain any new restrictions. It simply puts the lessee on "notice" that his operations must be in compliance with the applicable statute(s), such as the Endangered Species Act, if applicable at the time surface occupancy is proposed.

In addition to the two lease stipulations that may be required, there are two LNs that are used consistently:

- LN #3, which indicates that all or part of the leased lands may contain animal or plant species classified under the Endangered Species Act. All leases and permits issued will be subject to this lease notice.
- LN #4, which indicates that all or part of the leased lands may be classified as wetlands, floodplain, or riparian areas that will require special protection. All leases and permits issued where these areas are present will require this notice.

Issued leases are reviewed locally by the Forest Service to assure compliance with two basic requirements. Under Bureau of Land Management rules, an entity holding a coal lease cannot qualify for an oil and gas lease unless the coal lease is operating properly. In addition, leases must also comply with all rules and regulations issued by the Secretary of Agriculture when not inconsistent with the rights granted in the lease.

A lessee may request a modification waiver, or one-time exception of an NSO stipulation, or any other stipulation. The Forest Service may authorize the BLM to grant the change if: 1) the change is consistent with federal law and the local Forest Plan, 2) management objectives which led to the stipulation can be met following the change, and 3) the environmental impact of the change is acceptable. If the change substantially modifies the terms of the lease, public notice must be given at least 30 days before the results of an environmental analysis are approved (Federal Onshore Oil and Gas Leasing Reform Act of 1987).

In all cases where the minerals are privately owned, the Forest Service must obtain the best surface protection possible using the terms and the deed severing the subsurface from the surface estate, applicable state and federal laws (i.e. Endangered Species Act), and cooperation and negotiations with the operator.

There are 65 Federal oil and gas leases issued on the Daniel Boone National Forest covering 58,988.24 acres. There are currently 42 producing wells from these leases.

Salable Minerals

The Mineral Materials Act of 1947 authorized the disposal of mineral and vegetative materials through a sale system on U.S. public lands. The act also provides for free use of these materials by federal or state agencies, municipalities, or nonprofit associations as long as those materials are not for commercial, industrial, or resale purposes. The act was amended by the Multiple Use Mining Act of 1955, which defines "common variety mineral materials" and distinguished them from rare varieties (uncommon variety mineral material). Uncommon varieties of mineral materials may be locatable in certain states under the Mining Law of 1872.

Mineral materials or "common variety" minerals are commodities having a low value per ton, including sand, gravel, crushed stone, riprap, clay, and fill dirt. These materials are used in road construction, landscaping, and as building materials. They can be sold to individuals or companies through negotiated or competitive bidding or given as free use to public agencies (e.g., county and state highway departments) for public purpose use. Any sale of mineral materials must be made at no less than fair market value as determined by an appraisal. Sale of mineral materials is at the discretion of the local Forest, and it can choose not to do so as determined by the District Ranger. Currently there is one lease for limestone on the DBNF.

MINERAL OWNERSHIP

Mineral ownership on the DBNF is very inter-mixed, resembling the mosaic pattern of surface ownership within the proclamation boundary. Minerals underlying National Forest System land may be federally owned, "reserved" by the previous surface owners, or "outstanding" in third parties.

Federal Minerals

Mineral rights are those that have been acquired by the federal government through purchase, exchange, or donation.

Private Mineral Rights (Reserved and Outstanding Mineral Rights)

The authority for the administration of mineral reservations is contained in 36 CFR 251.15 or previously issued Secretary of Agriculture's rules and regulations governing mineral rights reserved in conveyances to the United States. Rules and regulations governing mineral rights are normally incorporated into deeds that that transfer surface ownership to the federal government. Forest

Service direction for the administration of reserved and outstanding rights is found in Chapter 2830 of Forest Service Manual 2800.

Private-mineral rights are exercised for both exploration and development of mineral resources in various locations on the DBNF. This section discusses how the Forest Service manages mineral exploration and development of Reserved and Outstanding Rights (ROR) under federally owned surface. In recent years the DBNF has overseen plans of operations on federal surface for development of private oil and gas, underground coal mining, and mineral material development.

An important difference in the administration of ROR is that exercise of those rights is not a privilege, but a right owned by a private party. As such, the Forest Service has no role in leasing, and the BLM is not involved in approval of an Application for Permit to Drill (APD). Since there is no lease or permit, there is no contractual agreement to be met. Reserved mineral rights are subject to state laws and Secretary's Rules and Regulations, which were made part of the severance deed when the surface was purchased by the United States. The most common version of the Secretary's Rules and Regulations dates from 1911 and does not require a permit. Later versions (1937, 1938, 1939, 1947, 1950 and 1963) did require a permit. In cases of reserved mineral rights, the Forest Service will approve an operation permit. For outstanding minerals, a minerals operation plan will be negotiated. Even though a permit is not specifically required, the operator must still develop and submit a plan of operation for review by the Forest and recommendations.

The following discusses two interrelated potential effects relating to outstanding and reserved mineral rights on the DBNF: 1) The potential effects of the 2004 Forest Plan on the exercise of private mineral rights on NFS lands, and 2) The potential effects of private mineral rights operations on NFS lands.

Exploration or development of privately owned minerals on NFS lands is a private, not a federal decision. Tens of thousands of acres on the DBNF were acquired subject to reserved or outstanding private mineral rights. All Forest Plans remain subject to these existing private rights.

A Comptroller General's Report to Congress (GAO/RCED-84-101; July 26, 1984) found that the Forest Service in the eastern U.S. failed to provide Congress with information about private mineral rights and their potential effect on wilderness management. The General Accounting Office recommendation to the Secretary of Agriculture stated: "Because the Forest Service did not analyze the potential problems or costs associated with private mineral rights when it developed its 1979 wilderness recommendations, GAO recommends that the Secretary direct the Forest Service's southern and eastern regional offices to do this type of analysis when re-evaluating its wilderness recommendations. This analysis should include for each area consideration of private mineral development potential, the government's ability to control mineral development if it occurs, the need to acquire private mineral rights, and a range of acquisition costs."

These problems (management conflicts, litigation, and high costs) apply not only to Wilderness, but to 1) any highly restrictive designation that conflicts with exercise of private mineral rights on National Forest System lands, and 2) management prescriptions that impose severe restrictions on use of the surface or prohibit certain activities such as road construction or mining. Examples include Special Biological Areas, Wild and Scenic River designations, Wilderness Study Areas, or backcountry recreation areas.

The 5th Amendment to the U.S. Constitution provides that private property shall not be taken for public use without just compensation. Designations or prescriptions that prohibit mineral development or are de facto prohibitions on mineral development can represent a "taking" of private property rights. For example, the time required to process private mineral activities under a Forest Plan's framework might result in unreasonable delays that amount to a "taking" of the mineral rights. Partial takings are also possible. Executive Order 12630, "Government Actions and Interference with Constitutionally Protected Property Rights," sighed in 1988, requires federal decision-makers to 1) evaluate carefully the effect of their administrative actions on private property rights, and 2) to show due regard to 5th amendment rights and to reduce the risk of undue or inadvertent burdens on the federal treasury. Concern about government "takings" of private property rights remains a national issue.

Since to access privately owned minerals is a right and not a privilege, it should be understood that restrictions and other stipulations regarding mineral development in the 2004 Forest Plan, such as prescription area standards and other restrictions on mineral development, apply only to federally owned minerals. Private mineral development will be managed by applicable state and federal laws, the deed of severance which separated the mineral estate from the surface estate, and the Secretary's of Agriculture's Rules and Regulations (if applicable).

Lands Involved

Of the 2,047,000 acres within the DBNF proclamation boundary, 693,726 are federally owned. Of the federally owned land, mineral rights for 406,341 acres are "reserved" by the previous surface owners or are "outstanding" in third parties. This division of ownership is illustrated in Table 3 - 15.

Table 3 - 15. Mineral ownership on the Daniel Boone National Forest.

Mineral Ownership	Acres	% of Total
100% of subsurface Privately Owned	406,341	59%
***100% of subsurface Federally Owned (NFS)**	235,696	34%
NFS has a partial interest in Minerals	51,689	7%
Total NFS surface ownership	693,726	

* Includes 168,000 acres of coal interest

SUPPLY AND DEMAND FOR MINERALS

Trends in the Demand for Minerals

The United States is one of the world's leaders in mineral consumption. Kentucky coal production far exceeds in-state coal use (Figure 3 - 7). Approximately 79 percent of Kentucky's coal production comes from the eastern portion of the state near the DBNF.[1] Nationally, petroleum resource imports have been on the increase for the past few decades. Figure 3 - 8 and Figure 3 - 9 shows that Kentucky's consumption of both petroleum and natural gas exceeds in-state production.

[1] Cole, L., E. Siegel, and L.W. Lyle. 2001. 2000 - 2001 State of Kentucky's Environment. Resource extraction section. Kentucky Environmental Quality Commission. Frankfort, KY. p. 135-155.

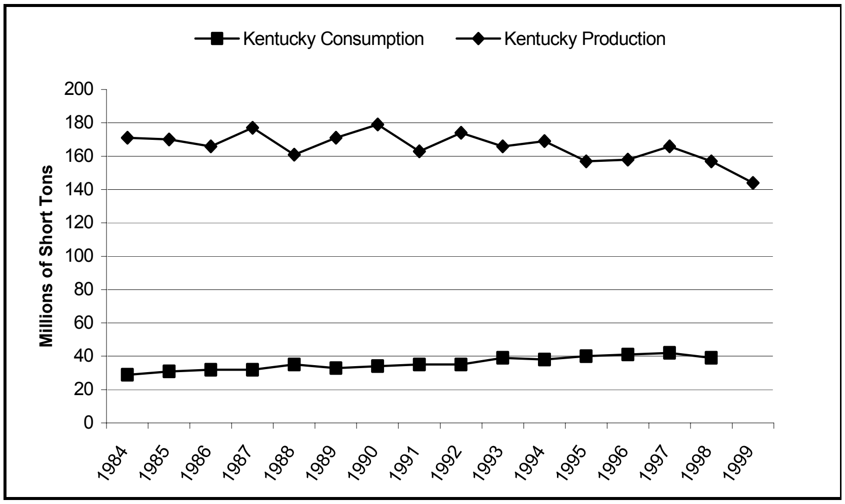

Figure 3 - 7. Coal Production/Consumption in Kentucky.

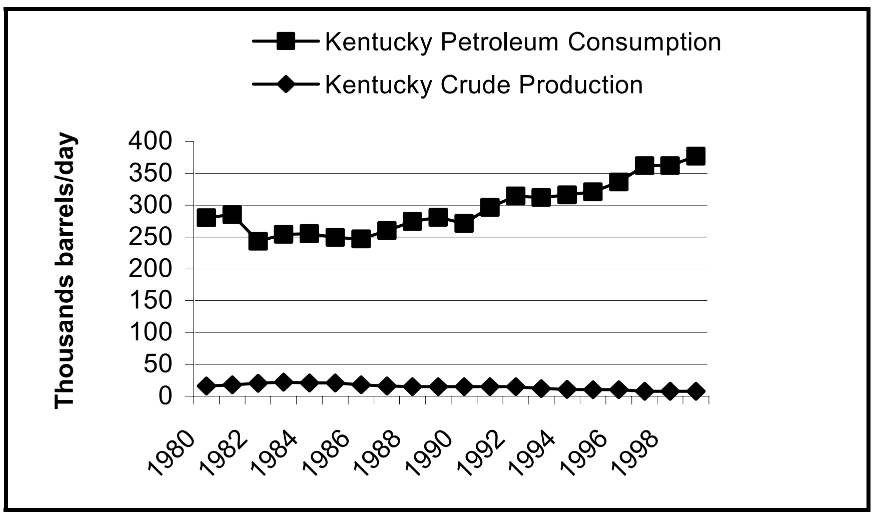

Figure 3 - 8. Petroleum Production/Consumption in Kentucky.

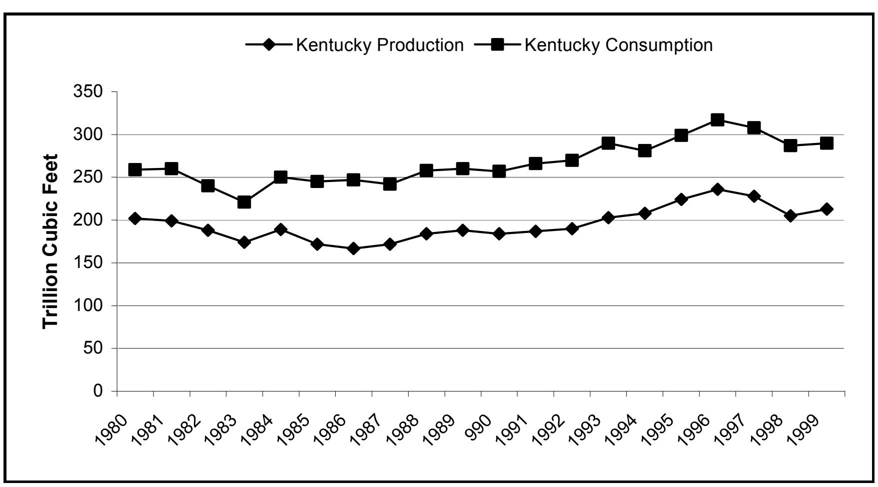

Figure 3 - 9. Natural Gas Production/Consumption in Kentucky.

Supply of Mineral Resources

The supply of petroleum and gas resources can be extended by more efficient use as well as conservation. While limited, Kentucky still has a vast supply of remaining coal resources. Many experts have varying opinions as to the future of mining in eastern Kentucky. It is clear however, that the potential for mining to occur on or near the DBNF during the next planning period is high. This is due to the interest in the development of coal that has increased over the last two to three years. This prediction was made over five years ago and new information could lower this estimate.

Comparison of Supply and Demand

Demand for mineral resources on the DBNF is likely to increase during the planning period. The gap between oil and gas consumption and production may continue to widen, and in the long-term, eastern Kentucky's coal resources will be depleted. National dependence on imports will likely increase unless new energy sources are developed.

Efforts to conserve minerals resources will depend on the level and cost of imports. Should import supplies become undependable or too costly, dependence on domestic production will increase.

Social, Economic and Environmental Implications

The trend of increasing consumption of coal, oil, and gas is illustrated in Figure 3 - 7 through Figure 3 - 9. Domestic production could be expected to increase in response to growing demand.

New job opportunities and higher incomes associated with increased domestic production should benefit local economies.

Increased production will also create environmental impacts. Some areas of concern include:

- Sedimentation from access and entry associated with coal development, subsidence form underground mining (no surface mining is allowed on the DBNF[2]), and acid mine drainage that may affect water quality and aquatic species.
- Sedimentation from access (road construction and use) and well pad construction associated with oil and gas development.
- The potential for ground water impacts if wells are abandoned and not adequately plugged.

Opportunities for Meeting the Nation's Minerals Needs

Domestic mineral needs can be met by increased imports and domestic production as well as new energy sources. Improving the business climate, encouraging minerals production on private lands, and facilitating minerals development on federal lands can enhance opportunities for increased exploration and development on the DBNF.

[2] Surface Mining Control and Reclamation Act of 1977

Constraints to Opportunities

The higher costs of new energy sources currently do not make them a feasible option for the near future. However, new developments may improve this option.

Uncertain profitability is not conducive for investment in mineral exploration and development.

Lack of information regarding mineral resources undermines confidence in the profitability of mineral development.

Forest Service staff shortages can inhibit development of federal lands on the DBNF.

Mineral Potential by Management Area

Figure 3 - 10 identifies the potential for coal, oil, and gas development on the DBNF. The rating categories are High, Medium and Low. The potential is essentially identical for each resource in the management areas, which is why they can be displayed on one map. Below is brief summary of the situation on the Forest for each resource.

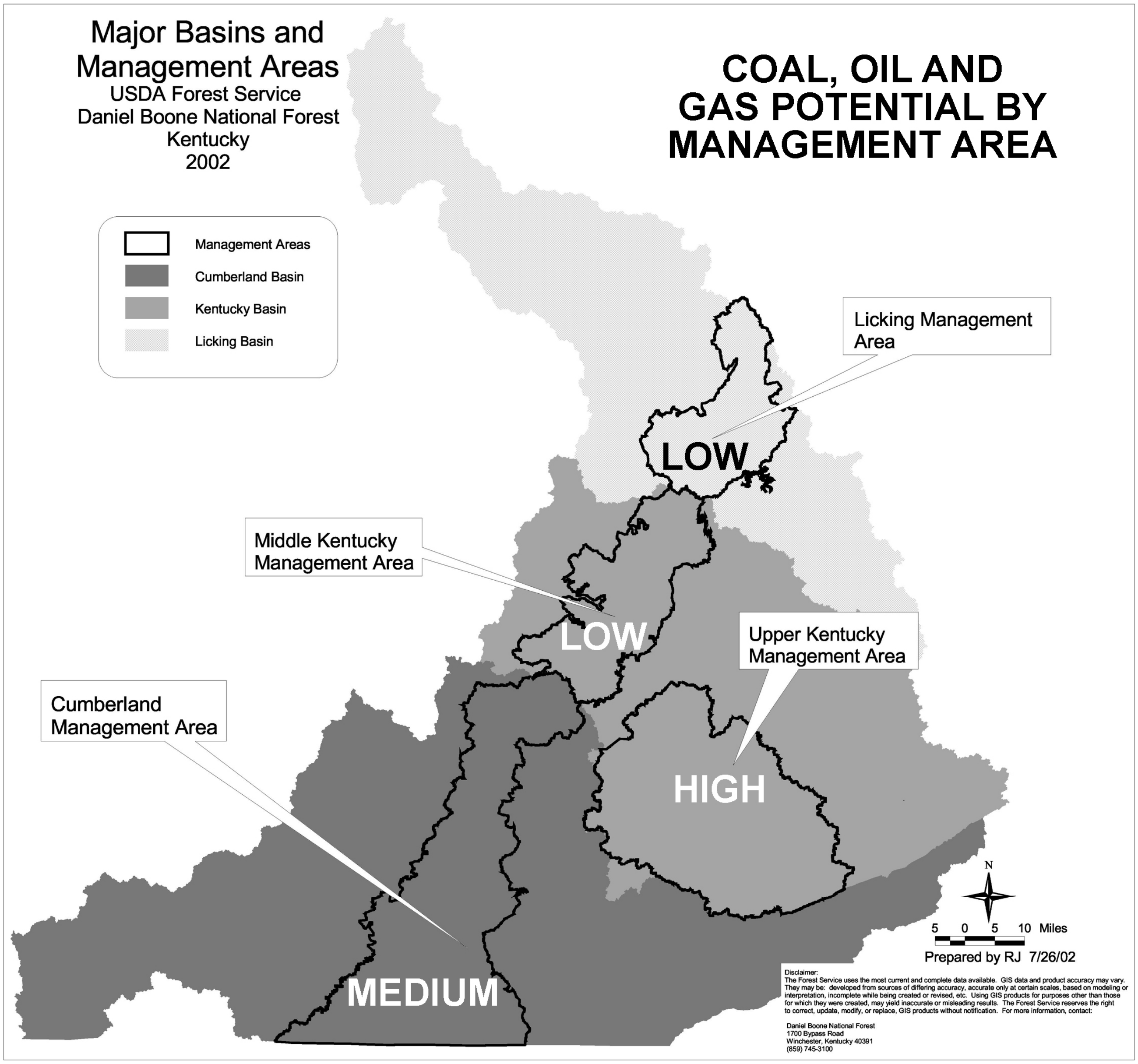

Figure 3 - 10. Mineral Potential by Management Area.

OIL AND GAS DEVELOPMENT

Oil and gas resources cannot be developed without surface disturbing activities such as constructing roads, laying pipeline, and pad location. Wells can be drilled on relatively small pads, however, and with good project administration, long-term surface effects can be minimized.

Reasonably Foreseeable Development Scenario (Oil & Gas)

The BLM's "reasonably foreseeable development scenario" for oil and gas is a model, or projection, of anticipated oil and gas exploration and development (leasing, exploration, development, production, and abandonment) in a defined area for a specific time (usually 10 years). The scenario is based primarily on the subsurface geology, past development history, current activity, and anticipated future demand. Consideration is also given to other significant factors, such as economics, technology, physical limitations on access, existing or anticipated infrastructure, and transportation. The rating system outlined in BLM Fluid Minerals Handbook H-1624-1 was used to determine the oil and gas potential of the DBNF. Its four rating levels include: High, Moderate, Low, and No Potential. These are defined as:

- High: Geologic environments that are highly favorable for the occurrence of undiscovered oil and/or gas resources. This includes areas previously classified as known geologic structures (KGS); inclusion in an oil and gas play as defined by the USGS national assessment, or in the absence of a play designation by USGS, the demonstrated existence of source rock, thermal maturation, and reservoir strata possessing permeability and/or physical evidence or documentation in the literature.
- Moderate: Geophysical or geological indications are favorable for the occurrence of undiscovered oil and/or gas resources. Evidence exists that one of the following may be absent: source rock, thermal maturation, and reservoir strata possessing permeability and/or porosity and traps. Geologic indication is defined by geological inference based on indirect evidence.
- Low: The geologic, geochemical, and geophysical characteristics do not indicate a favorable environment for the accumulation of oil and/or gas resources. Specific indications that one or more of the following may not be present: source rock, thermal maturation, or reservoir strata possessing permeability and/or porosity, and traps.
- No Potential: Demonstrated absence of source rock, thermal maturation, or reservoir rock that precludes the occurrence of oil and/or gas. Demonstrated absence is defined by physical evidence or documentation in the literature.

Oil and gas potentials vary across the Forest. The Redbird Ranger District has High potential while the Stearns Ranger District rates Moderate potential. The remainder of the Forest is rated at Low potential.

In the next 10 years, the RFD predicts that four wells will be drilled on the Forest to recover federally owned minerals while 12 wells are likely to be drilled for private minerals. These developments are most likely to occur on the Stearns or Redbird ranger districts. Table 3 - 16 shows the recent development trend for oil and gas on the DBNF. Approximately 80 percent of the wells drilled on the Redbird and Stearns districts will likely be natural gas producers. Approximately 13 percent will be dry holes and approximately, while 7 percent will be produce oil will yield a mixture of oil and natural gas.

Table 3 - 16. Wells Drilled on DBNF land from 1985-Present

COUNTY	Number of Wells	Gas	Dry	Oil	Oil/Gas
Clay (Redbird RD)	100	92	2	2	4
Jackson (London RD)	5	4	1	0	0
Lee (Stanton RD)	1	0	0	1	0
Leslie (Redbird RD)	34	15	7	2	10
McCreary (Stearns RD)	14	12	2	0	0
Menifee (Stanton/Morehead RD)	2	0	2	0	0
Owsley (Redbird RD)	6	4	2	0	0
Perry (Redbird RD)	0	0	0	0	0
Powell (Stanton RD)	1	1	0	0	0
Whitley (Stearns RD)	16	14	2	0	0
Total	179	142	18	5	14

This Reasonably Foreseeable Development Scenario describes the geology and the potential for petroleum occurrence on the DBNF in eastern Kentucky. It also projects the amounts of activity that could occur during the planning period (10 to 15 years).

The DBNF has had a long history of minerals activity. As of January 1, 2003, there were three active coal leases and three actions pending (one lease modification and two new lease requests). Oil and gas leases were being developed on the Forest as well.

Typical Drilling Scenario and Well Design

To fully evaluate the impacts associated with hydrocarbon exploration and development, the various activities typical of these actions should be identified and analyzed.

Well site preparation includes construction of a drilling pad as well as a reserve pit to capture drilling by-product. A typical site layout for an oil well drilled as deep as 6,000 feet can cover one to two acres. In eastern Kentucky, wells typically are drilled for less than 6,000 feet and well sites usually cover only one-half to one acre. The site is cleared and graded for construction of the well pad and reserve pit. Depending on the topography of the well site and access area, this construction may require the creation of cut slopes and fill areas. The reserve pit is usually excavated to a depth of about five feet and is lined with a plastic or butyl liner (or its equivalent) that meets state standards for thickness and quality. Constructed access roads normally have a running surface (width) of approximately 15 feet and a right-of-way of 30 feet. The length depends on the well-site location in relation to existing roads or highways. The anticipated length of road construction is about a half mile or less.

Because the cost of drilling rig time is usually several thousand dollars a day, drilling is conducted around the clock when possible. Wells are usually drilled and tested in approximately 30 days. However, the actual time will depend on the depth of the hole, the number and degree of mechanical problems, whether a hole is dry or a producer, and other related factors.

Natural gas in eastern Kentucky is dry, making air drilling is the most effective method. Wells are usually drilled by rotary drilling rig employing an air-mist as the circulating medium. Air compressors force air down the drill pipe to propel rock cuttings out of the well bore.

Two or more diesel engines provide power for the rig and air compressors. Water is required to control dust created when the compressed air returning from the well bore blows rock cuttings into the reserve pit. This water is normally trucked to the site. However, water could be pumped to the site from a local pond, stream, or lake through pipe laid on the surface.

If water is encountered during drilling, an unlikely prospect, drilling can resume using drilling mud. Approximately 800 barrels of drilling mud will be kept on the location. Mud will also be needed for some data logging programs.

Because the natural gas in the area is dry, very little water is associated with its production. Any separation, dehydration, or other necessary processing will likely be conducted off the project.

If material used in construction of the well pad or access road (i.e., rock, shale, or gravel fill) is obtained on or near the site, it must be obtained from pre-approved sources. Shale and/or gravel used in construction of the drilling pad must be stockpiled when restoring the area. For all surface-disturbing activities, the topsoil to be removed will be stockpiled for redistribution over the disturbed area prior to fertilizing and re-seeding of the site. In areas where excavation will be extensive or extreme, or where bedrock will be encountered, existing topsoil must be replaced. Restoration of the area will include reseeding with natural grasses as determined by the local Forest Service specialist. If drilling results in a producing well, the drilling pad must be reduced to a maximum area of 2,500 square feet and the remainder restored to blend into the natural terrain.

Whenever possible, pipelines and/or flow lines will be constructed in conjunction with the construction of access roads to minimize disturbance. Pipeline rights-of-way shall not exceed 25 feet in width. DBNF personnel may set exact right-of-way widths. Pipeline depth must be at least 48 inches. When possible, a common point of collection shall be established to minimize the number of production sites. All pipeline designs, construction, operation, and maintenance must comply with Federal Safety Standard for Gas Lines (49 CFR 192) unless more stringent requirements are required by the state of Kentucky.

Oil and Gas Plays on the Daniel Boone National Forest

Oil and gas has been developed for decades on the DBNF, beginning in the late 1800s. Despite this long history of development, many oil and gas plays remain. Oil and gas plays can be found in the following six geologic production zones that occur on the DBNF. Most production occurs on the Stearns and Redbird Ranger Districts.

- Upper Mississippian Mauch Chunk Group
- Upper Mississippian Greenbriar/Newman Limestones
- Lower Mississippian Weir Sandstones
- Upper Devonian Black Shales
- Lower Devonian/Upper Silurian Unconformity Play
- Cambrian-Ordovician Knox Group

Table 3 - 17. Age in geologic time of the oil and gas plays on the DBNF.

ERA	SYSTEM AND SERIES		MYPB
Cenozoic	Quaternary	Holocene	0.01
		Pleistocene	1.8
	Tertiary	Pliocene	5
		Miocene	23
		Oligocene	34
		Eocene	57
		Paleocene	65
Mesozoic	Cretaceous		144
	Jurassic		208
	Triassic		245
Paleozoic	Permian		286
	Carboniferous Systems	Pennsylvanian	320
		Mississippian	360
	Devonian		408
	Silurian		438
	Ordovician		505
	Cambrian		544

MYBP = million years before the present.

Upper Mississippian Mauch Chunk Group

This group extends from Pennsylvania, West Virginia, and Virginia into Kentucky. A conservative estimate for the cumulative production from the Mauch Chunk reservoirs is 336 bcf (billion cubic feet), based on 4,200 wells with an average production of 80 MMcf from each well. In Kentucky, the earliest gas production appears to have been in Martin County from the Pennington formation in 1899. Since that time, gas has been produced from 68 fields in 16 counties (Barlow 1996). Production from this zone is mainly in extreme eastern Kentucky including Breathitt, Floyd, Martin, and Pike counties. However, some production has extended into the southern end to the DBNF, including Whitley and Leslie counties.

Upper Mississippian Greenbriar/Newman Limestones

The Upper Mississippian Greenbriar/Newman Limestones extend from parts of southeastern Ohio to West Virginia, Virginia, and Tennessee and into eastern Kentucky. Approximately 3,400 wells produce from the Newman Limestone in 257 fields in eastern Kentucky. Production areas near the DBNF occur in Clay, Leslie, Whitley, Jackson and Owsley counties. Newman Limestone produces natural gas from two zones. These “pay” zones are confined to long and narrow tidal, fluvial, or estuarine channels running in mostly north-south direction. This production area is commonly known as the “Big Lime.”

Lower Mississippian Weir Sandstones

The Weir Sandstones production area of West Virginia, southwestern Virginia and eastern Kentucky consists of several major oil and gas plays, especially in extreme eastern Kentucky. Areas of the DBNF with potential for Weir Sandstone development (based on past trends) can be found in Clay, Laurel, Leslie, and Whitley counties. This sandstone occurs in the Lower Mississippian formations of eastern Kentucky, but several production intervals have created producing wells. These intervals are known as the Stray Gas sandstone, 1st Weir, and 2nd Weir. There has been mixed production from this zone with development of both oil and gas.

Upper Devonian Black Shales

The Upper Devonian Black Shale production occurs in eastern Kentucky, West Virginia, and Ohio. The heaviest gas production in Kentucky occurs in Knott, Floyd, and Pike counties. Portions that extend into the DBNF occur primarily in the Redbird Ranger District. Natural gas was discovered from in this zone in the late 1800s, and by 1935, it was known as one of the largest gas plays in the United States. This production zone is associated with the rock sequence from the bottom of the Berea Sandstone to the top of the Onandaga Limestone. The Big Sandy gas field (located in eastern Kentucky, just east of Leslie County), part of the Upper Devonian field, has been the major contributor to production from this zone. Cumulative gas production for the Devonian Black shale's has been approximately 3 trillion cubic feet (tcfg) from roughly 10,000 wells (Boswell 1986). Of this production, 2.5 tcfg was likely produced from the Big Sandy field (Roen and Walker 1996).

Lower Devonian/Upper Silurian Unconformity Play

The Lower Devonian/Upper Silurian Unconformity Play, located in eastern Kentucky, has a grouping of natural gas plays that have been developed on the DBNF in Clay County. Earliest discoveries were found in Morgan and Menifee counties in 1902 and 1904 respectively. Some depleted plays in this field were being used as gas storage fields by the 1970s and 1980s. Cumulative past production is estimated at between 80 to 110 bcfg. The Silurian Salina and the Lockport Dolomite are two major producing formations of this zone.

Cambrian-Ordovician Knox Group

The Cambrian-Ordovician Knox Group is located in western New York, Pennsylvania, central Ohio, eastern Kentucky, and northern Tennessee. The majority of oil and gas plays in Kentucky are found in Clay and Clinton counties. The earliest Kentucky discovery in this zone occurred in Clinton County in 1941. Production in the Clay County area began in the 1950s. Development outside the two larger fields has taken place in the Big Sinking area of Lee County. Production from the Cambrian-Ordovician Knox Group has decreased and in some cases has been entirely depleted. The Knox Unconformity Play produces for this group. The stratigraphy of this play is listed below in descending order:

- The Beekamtown Dolomite
- The Rose Run Sandstone
- The Upper sandy member of the Gatesburg Formation
- The Theresa Formation
- The Copper Ridge Dolomite
- The Sandstones in the upper Copper Ridge Dolomite
- The Krysik Sandstone
- The Lower Copper Ridge Dolomite

An area on the Stanton Ranger District has a history of oil production through secondary recovery. The market could still encourage development on the district if demand grows sufficiently. This area has been inactive for the last 5 to 10 years.

EXISTING LEASES (COAL, OIL, GAS)

There is one lease in McCreary County covering 470.79 acres, 36 leases in Clay County, covering 16,411.6 acres and 20 producing wells, six leases in Whitley County covering 11,718.97 acres and 8 producing wells, 17 leases in Leslie County covering 30,386.88 acres and 14 producing wells, and 5 leases in Owsley County covering 437.29 acres.

Minerals across the Forest have been available for leasing, but the No Surface Occupancy (NSO) stipulation has often been applied to development activities. Operators who drill wells to recover private minerals and also want to recover federally owned minerals with their producing units must join with the federal government and its lessee in a Communitization Agreement.

Coal mining may not be heavily impacted by NSO stipulations as the most recent trend is for mines to approach federal land underground from privately owned portals. However, oil and gas leasing is likely to be affected by NSO stipulations, which may limit development or discovery of oil and gas fields. Figure 3 - 11 shows tracts currently under lease or have leasing proposals under consideration. The figure also shows that most mineral development activity on the Forest is taking place on the Redbird District while the southern half of the Forest has more mineral development underway than the northern portion.

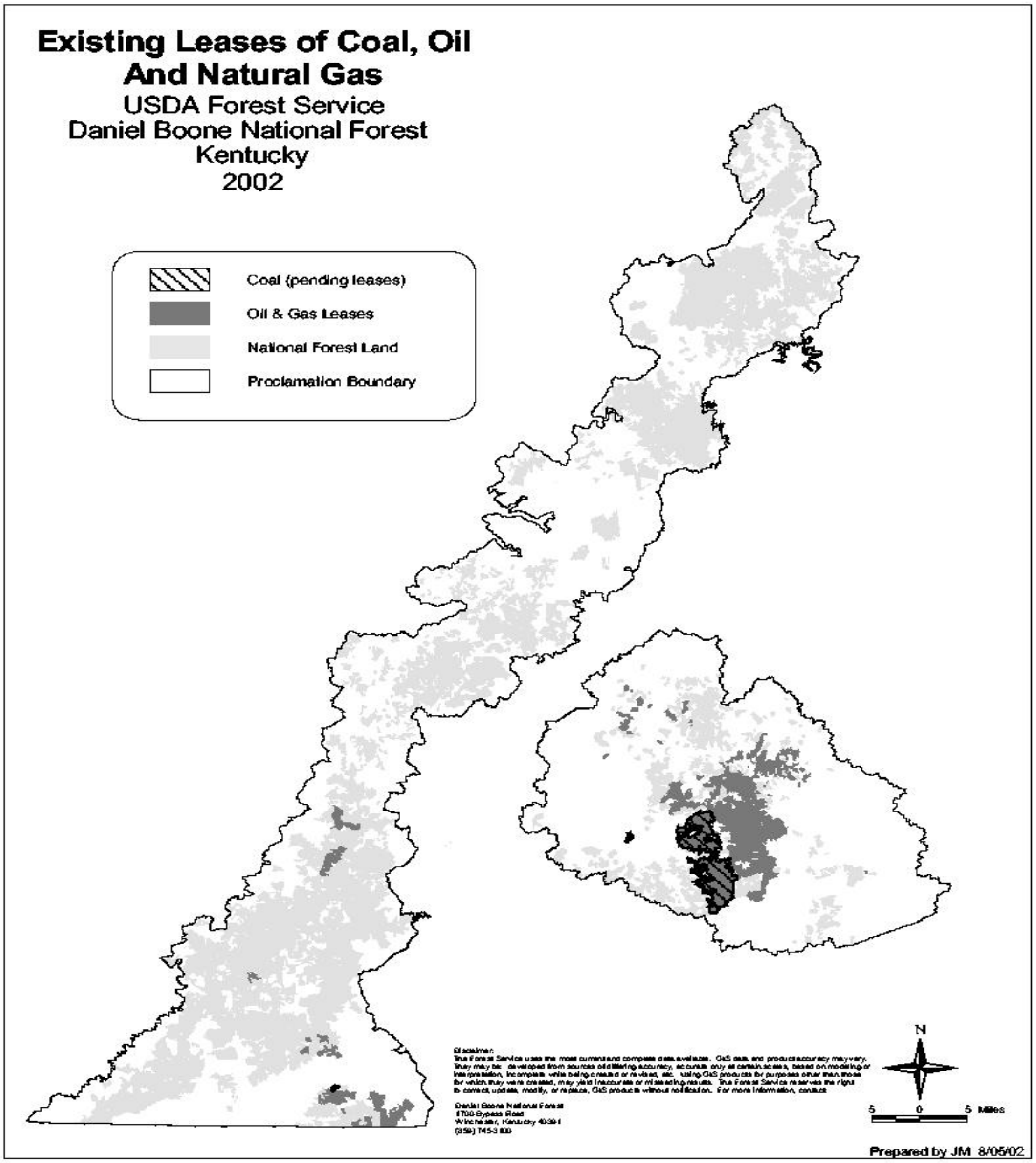

Figure 3 - 11. Existing Leases of Coal, Oil and Natural Gas on the DBNF.

Past Mineral Production and Revenues

Leasing on the DBNF has fluctuated widely over the last 10 years for a number of reasons. Figure 3 - 12 to Figure 3 - 14 illustrate the decrease in royalties generated by coal and oil resources on the Forest since 1995. The Forest has seen a slight increase in royalties from natural gas during the same period, however. A dramatic increase in these numbers has been forecast, especially for coal royalties, because of pending lease applications.

For some time, the market for oil has not been favorable for the kind of wells typically drilled on the DBNF. Most are "stripper" wells that produce marginal flows and operate on the lower edge of profitability. Many of the oil wells in production approximately 20 years ago were secondary "recovery" wells. Recovery operations inject water underground to help move oil toward production wells. Oil is unlikely to be a major component in the DBNF minerals program unless two variables change:

- Market conditions improve significantly making stripper wells more profitable.
- Conditions in the international arena create a climate in which domestic production is emphasized.

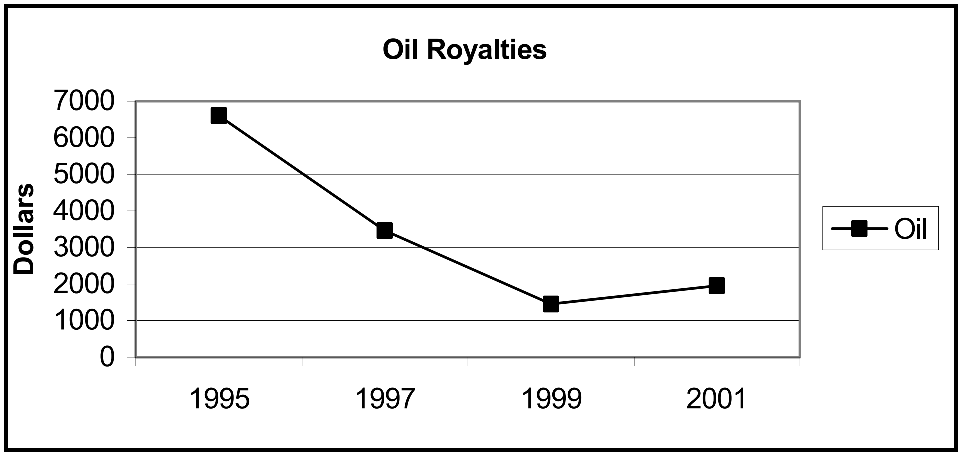

Figure 3 - 12. DBNF Oil Royalties

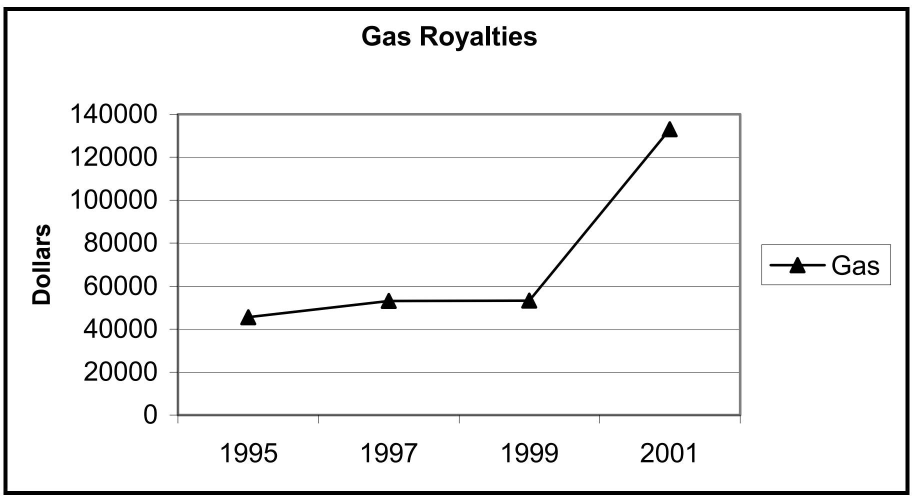

Figure 3 - 13. DBNF Gas Royalties.

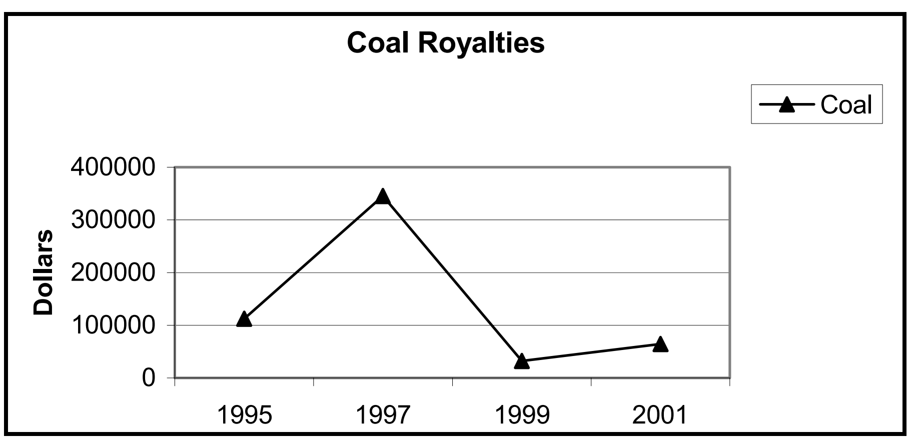

Figure 3 - 14. DBNF Coal Royalties.

Oil and Gas Production

Natural gas has been produced on most all DBNF ranger districts. Within the last 15 years, however, the bulk of development has occurred on the Stearns and Redbird Ranger Districts, mostly on private mineral rights. The development scenario during the planning period (10 to 15 years) should remain steady as it has for some time. Natural gas production in Kentucky from 1992 to 1999 remained between 75 and 80 billion cubic feet annually.[3] There should be a growing interest in development of federally owned resources as new deposits are discovered.

Oil development across the Forest has declined since approval of the 1985 Forest Plan. Oil recovery on the DBNF has mainly been a by-product of natural gas production. Wells intended to produce natural gas sometimes discover paying quantities of oil. New fields or pools will have to be discovered for interest in oil to increase. However, market conditions could create opportunities for further development of oil producing pools found on the Stanton and London Districts.

Coal Production

The Redbird district has seen the most coal development in the last 10 years. Pockets of coal of suitable thickness for underground mining are still found on this district. The Redbird district could contribute heavily to an increase in mineral royalties.

The Stearns and Somerset districts lie on the westernmost extent of the eastern Kentucky coalfield, and the bulk of coal in this area was depleted some 40 years ago. The Stearns district still has some activity, however. Mines on the Stearns and Somerset districts have often encountered problems with acid drainage. Coal seams in these districts tend to be less consistent in extent than those on the Redbird area.

Coal revenues have decreased over the period surveyed in Figure 3 - 14. Many of the mines leased since 1985 have completed operations. Several factors could change coal royalties during the next planning period:

- In the year 2000, the Tennessee Valley Authority transferred 40,000 acres of coal mineral rights to the DBNF.
- Two active leases were transferred along with the coal mineral rights.
- Three lease requests for coal development on the Forest are undergoing evaluation.

COAL RESOURCES

The DBNF covers only a small portion of the eastern Kentucky coalfield, but coal resources are present in all six ranger districts. Coal recoverable for commercial purposes is found mostly on the Redbird and Stearns ranger districts, and both have high coal potential.

The Redbird Ranger District had an estimated 201 million tons of federally owned coal resources remaining in 2002. Whitley and McCreary counties, located on the southern portion of the Forest and mostly on the Stearns Ranger District, contain approximately 57 million tons of remaining

[3] Cole, L., E. Siegel, and L.W. Lyle. 2001. 2000 - 2001 State of Kentucky's Environment. Resource extraction section. Kentucky Environmental Quality Commission. Frankfort, KY. p. 135-155

federally owned coal resources. Forestwide, about 320 million tons of federally owned coal resources remain. However, the amount of coal that can be profitably mined may be much lower because only underground mining is allowed on DBNF land. Pennsylvanian coal-bearing formations are either thin or absent in the four other Ranger Districts -- Morehead, Stanton, London, and Somerset -- giving them only moderate potential for development of federally owned coal.

The Eastern Kentucky Coal Field includes all or parts of 37 counties in Kentucky, covering 10,500 square miles (6.7 million acres). The 700,000 acres of federally owned land in the DBNF lies in 22 of these counties covering about 10.4 percent of the coalfield (Figure 3 - 15)[4].

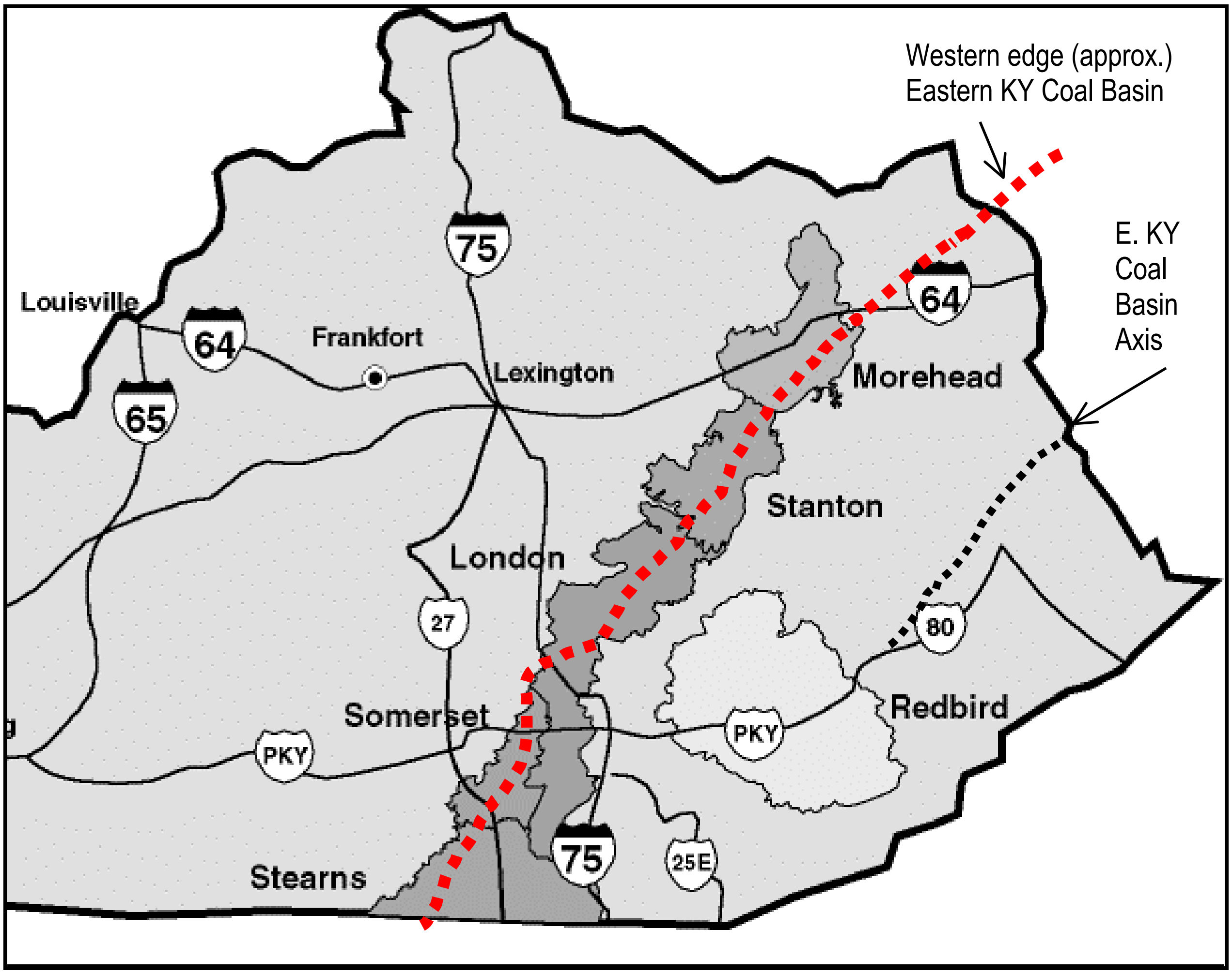

Figure 3 - 15. Interface of Eastern Kentucky Coal Basin with DBNF Ranger Districts.

Regional Geology

The DBNF lies in the eastern Kentucky portion of the Appalachian Basin in an area known as the Cumberland Plateau. The Rome Trough, containing a thick lower Paleozoic section and trending NE-SW across eastern Kentucky, significantly influenced pre-Mississippian sedimentation in eastern

[4] Eastern Kentucky Coal Field, Daniel Boone National Forest – Coal Assessment June 2002.

Kentucky. Structurally, the DBNF portion of the basin has been subject to minor local folding and faulting compared to the Valley and Ridge Province to the east. Generally flat-lying Pennsylvanian rocks are at the surface across most of the Forest. These Pennsylvanian strata consist largely of sandstone, siltstone, shale, and coal beds with some thin marine shale and limestone units. These deposits indicate that Kentucky was near sea level during the Pennsylvanian age, alternately covered by lakes, extensive swamps, shallow bays, and estuaries. Piedmont, alluvial, and coastal plain environments extended across the state at times during the Pennsylvanian period resulting in depositions of strata that today form the Eastern Kentucky Coal Field. The western edge of the Eastern Kentucky Coal Basin (Figure 3 - 15) is located along a NE-SW trend that cuts across all of the DBNF Ranger Districts except Redbird. This western boundary is a topographic feature known as the Pottsville Escarpment. It is the eroded edge of resistant Pennsylvanian-age sandstones and conglomerates on outcrop where they overlie the Mississippian rocks in eastern Kentucky.

Local Geology - Coal

The Pennsylvanian Breathitt Group, which lies at the surface, is the coal-bearing unit in eastern Kentucky. Figure 3 - 16 is a stratigraphic column of eastern Kentucky. The subsurface presence of several of the top coal-producing formations, the Hyden, Four Corners, and Princess Formations on the Redbird District gives it by far the most coal potential of any DBNF ranger district. The remaining DBNF districts have the Pikeville, Grundy, Bee Rock Sandstone, Alvy Creek, and Sewanee Sandstone Formations in the subsurface or on outcrop. With the exception of the Redbird District, three out of four of the main coal-producing horizons (Princess, Four Corners, and Hyden Formations) are not present on 79 percent (552,614 acres) of the DBNF.

The westernmost surface exposure of the Pennsylvanian Breathitt Group (Pottsville Escarpment) defines the limits of the Eastern Kentucky Coal Field. The coal-bearing formations thin to the northwest toward this outcrop. Pennsylvanian formations dip basinward (east) at about 40 feet per mile. As mentioned above, most of the DBNF lies outside the coalfield to the west of this escarpment (Figure 3 - 15).

In the northern part of the Forest, the western limit of the Breathitt Group is located near the eastern boundary of the Morehead and Stanton districts. Therefore, little coal production should be expected in those areas.

In the central part of the Forest, the western limit of the Breathitt Group outcrop is located near the boundary of the London and Somerset districts with the Somerset lying mostly west of the Breathitt Group outcrop. Consequently, little coal production should be expected on the Somerset District. The southern part of the London District does have coal potential, however.

The Breathitt Group is found on the Stearns Ranger District in the southern Forest giving it coal potential. The outcrop limit is located near the western boundary of the District and Forest. Across the entire Redbird District the Pennsylvanian Breathitt Group is at the surface. This district, therefore, has all the principal coal bearing formations on outcrop or in the subsurface. The Pennsylvanian coal bearing Breathitt Group outcrop patterns have the same NE-SW trend as the DBNF Districts (Figure 3 - 15). The axis of the Eastern Kentucky Coal Basin lies near the eastern boundary of the Redbird District.

The Fire Clay coal seam, historically the second largest producer in eastern Kentucky, occurs only on the Redbird District. The area of potential coal recovery from beneath the forest surface is further limited by the ban of surface mining that applies to the DBNF. Current mining practices relative to the number of feet on overburden and proximity of underground works to the surface, further reduce the likelihood of mining in areas where the Pennsylvanian Breathitt Group is of limited thickness.

Western Europe State	Mid-continent USA	North American Series	Eastern Kentucky Group	Eastern Kentucky Formation	Major Coal Beds and Coal Zones *Major Marine Zones*
Westphalian D	Desmoinesian	Middle Pennsylvanian	Breathitt	Princess	Princess No. 9 Princess No. 8 Princess No. 7 Princess No. 6 Princess No. 5a, 5b Princess No. 5, Richardson, Skyline
Bolsovian	Atokan			Four Corners	*Stoney Fork Member* Broas Peach Orchard Arnen Member Hazard Haddix
Duckmantian				Hyden	*Magoffin Member* Taylor Hamlin *Fire Clay rider* Fire Clay Whitesburg
				Pikeville	*Kendrick Shale Member* Amburgy Elkins Fork Shale Upper Elkhorn No. 3 Alma *Crummies Member* Lower Elkhorn Little Eagle
Langsettian	Morrowan	Lower		Grundy	*Betsie Shale Member* Clintwood Millard *Unnamed marine zone* Hagy Splash Dam / Barren Fork Elswick / Stearns

Figure 3 - 16. Pennsylvanian Stratigraphy of Eastern Kentucky.

(Source: Kentucky Geological Survey, Map and Chart Series XII 2000)
Bureau of Land Management, Jackson Field Office, May 2002

Ranger District Summaries North to South

The **Morehead Ranger District** has 119,027 surface acres in parts of Bath, Menifee, Morgan, and Rowan counties of the Licking River Coal District in eastern Kentucky. The Pennsylvanian Formation is less than 400 feet thick. The Alvy Creek and Grundy Formations are at the surface. There is no potential for Fire Clay or Fire Clay Rider coal here because this district lies west of where these seams' can be developed. There is no Upper Elkhorn or Lower Elkhorn coal in this district.

The **Stanton Ranger District** has 62,425 surface acres in parts of Estill, Lee, Menifee, Powell, and Wolfe counties in the Southwestern and Liking River Coal Districts of eastern Kentucky. The Pennsylvanian is less than 400 feet thick. The Alvy Creek and Grundy Formations are at the surface. There is no potential for Fire Clay or Fire Clay Rider coal because this district lies west of where these seams can be developed. There is no Upper Elkhorn or Lower Elkhorn coal in this district.

The **London Ranger District** has 178,566 surface acres in parts of Estill, Jackson, Laurel, Lee, Owsley, Pulaski, Rockcastle, and Whitley counties in the Southwestern Coal District of Eastern Kentucky. The Grundy and Pikeville Formations are at the surface. There is no potential for Fire Clay or Fire Clay Rider coal because this district is west of where these seams can be developed. There is no Upper Elkhorn or Lower Elkhorn coal in this district.

The **Somerset Ranger District** has 78,380 acres in parts of McCreary and Pulaski counties in the Southwestern Coal District of eastern Kentucky. The Grundy and Pikeville Formations are at the surface. There is no potential for Fire Clay or Fire Clay Rider coal because this district lies west of where these seams can be developed. There is no Upper Elkhorn or Lower Elkhorn coal in this district.

The **Stearns Ranger District** has 114,216 surface acres in parts of McCreary, Wayne, and Whitley counties in the Southwestern Coal District of eastern Kentucky. In the Stearns District, the Pennsylvanian is 400 to 850 feet thick, according to data on regional cross-sections (Chestnut 1992). There is no potential for Fire Clay or Fire Clay Rider coal because this district lies west of where these seams can be developed. The Grundy and Pikeville Formations are at the surface. There is no Upper Elkhorn (No. 3A) except for a seam less than 14 inches thick along the southern portion of the Whitley-McCreary County line. The Lower Elkhorn seam is less than 42 inches thick along the southern portion of Whitley-McCreary county line. There is no Lower Elkhorn elsewhere in this district.

The **Redbird Ranger District** has 145,288 surface acres in parts of Clay, Harlan, Knox, Leslie, Owsley, and Perry counties in the Southwestern and Hazard Coal Districts of eastern Kentucky. This district has the most favorable geology for coal production of any on the Forest. Major coal beds in the Eastern Kentucky Coal Field are typically the thickest and most continuous in the southeast portion of the state toward Pine Mountain and thinner to the northwest (Cobb and Chestnut 1989). Along the western edge of Redbird District, the Pennsylvanian formation is 350 to 750 feet thick, according to data on regional cross-sections (Chestnut 2002). It dramatically thickens across the Redbird District to the east into eastern Leslie County where it is in excess of 3,000 feet thick near the axis of the Eastern Kentucky Coal Basin. Prolific coal-bearing formations of the Breathitt Group (Princess, Four Corners, Hyden, and Pikeville) are well developed on the Redbird District. The Fire Clay seam of the Hyden Formation is historically one of the better producers of coal in eastern Kentucky. The district has potential for coal from the Fire Clay (Hazard # 4) and Fire Clay Rider coals. The Hyden, Four Corners, and Princess Formations are at the surface. The Upper Elkhorn (No. 3A) is 14 to 28 inches along Clay-Leslie county line and the Lower Elkhorn is 0 to 14 inches elsewhere.

Drilling for coal bed methane (CBM) occurred in 1998-2000 on the Redbird District (Beverly Quadrangle) in southeastern Clay County along the Bell-Clay County line. Objectives are coals in the Pikeville and Hyden Formations of the Pennsylvanian Breathitt Group at depths from 350 feet to 1,600 feet. Wells have initial potentials from 20 to 100 MCFGPD and are sporadically produced at the present time by NAMI Resources. Wells are too widely spaced and have an insufficient gathering system to compete with gas line pressures of deeper conventional gas wells. The lack of more CBM wells as well as line pressure problems has slowed the progress of CBM development.

With the reported average gas contents of 52-90 cubic feet/ton (Kelafant and Boyer 1988), the potential in this area for undiscovered, recoverable CBM is probably limited but still exists (Lyons 1996).

Coal Deposits

Past mining in the Eastern Kentucky Coal Field has concentrated on areas where coal is most accessible, resulting in the depletion of easily recovered resources. Deeper, harder-to-recover coal deposits will become increasingly important in the future. Furthermore, research indicates that methane gas contained in deep coal resources in the Eastern Kentucky Coal Field may also be recoverable (Kentucky Geological Survey 2002a). Some initial coal-bed methane (CBM) drilling has occurred in the Redbird Ranger District in Bell and Clay counties. CBM wells in Clay County have total depths of 1,100 to 1,300 feet and are reported in the Lower Elkhorn Coal. This Clay County producing coal is approximately 1,400 feet deeper stratigraphically than the Hazard #8 and in a below drainage position. Tests of CBM wells in this immediate area indicate rates of 15 to 100 thousand cubic feet of gas per day (MCFGPD). The depth of coals is an important consideration for CBM potential. Shallow coals (less than 300 feet) tend to have very low CBM content because much of the methane has leaked to the atmosphere. Furthermore, gas contents of coals in above-drainage mines are predicted to be very low (Lyons 1996). In 1957, two wells in the Carter Coordinate section KY 9-E-74, Harlan County, were completed in unknown coals with initial open flows of 75 and 80 MCFGPD.

Coal Production History

Coal has been produced in eastern Kentucky since 1800 when production of 100 tons was reported. Since then, the Eastern Kentucky Coal Field has produced more than 5.5 billion tons of coal. Coal is currently mined in approximately 45 different seams in eastern Kentucky.

Figure 3 - 17. Cumulative Eastern Kentucky Coalfield production in billions of tons.

Source	Tons produced
Underground	3.73
Surface	1.55
Undetermined	0.29
Total	5.57

In the year 2000, approximately 57.5 percent of eastern Kentucky's coal production came from underground mines. Nineteen counties in eastern Kentucky produced coal in the year 2000 (Kentucky Coal Production 2002).

Status Record Data – Coal Leases

As of July 31, 2002, there were four coal leases on the DBNF with four applications pending. Mineral ownership figures are based on Forest Service records.

Mills and/or Plants

The existing coal leases operate their own coal processing plants. Typically, continuous miners develop mains and submains to facilitate panel development. One continuous mining unit is used as the means of extraction and delivery to the conveyor belt but a second unit can be added should economic conditions allow. When coal is mined, the raw product consists of coal and rock; rock is collected from small partings in coal that cannot be avoided during the mining process. After coal is delivered to a stockpile outside an underground mine, it is trucked to a preparation plant where it is washed, cleaned, and concentrated to eliminate the rock, including pyrite (a primary source of sulfur in coal). Processed coal is then transported to a train loadout (Kentucky Geological Survey 2002b).

Production and Marketing

Coal mined in Kentucky is mostly used for electricity generation, heating, and coking coal for iron and steel production. These uses have specific requirements, but generally demand a high BTU value. A low sulfur, ash, and moisture content are also desirable. Eighty-one percent of Kentucky coal is used for electricity generation. The removal of chemical constituents in coal such as sulfur, chlorine, sodium, and various air pollutants is important for some uses of coal. "Washability" is a factor for measuring how easily chemical constituents and ash content can be reduced before coal is burned (Kentucky Geological Survey 2002c).

Coal Potential and Resource Estimate

Approximately 79 percent of Kentucky's annual coal production comes from the Eastern Kentucky Coal Field. Although generally lower in sulfur content and ash yield than coal from the western Kentucky coal, eastern Kentucky coal is highly variable in thickness and quality. Many eastern Kentucky coals are composed of distinct benches of coal separated from each other by thin but widespread partings. Often these benches are of varying quality and thickness (Kentucky Geological Survey 2002d). The bulk of Kentucky's substantial remaining coal seams are only 14 to 42 inches thick. These generally occur below drainage or are of poorer quality than what is currently mined. The next generation of mining will most likely be in deeper parts of the coal basins. The Kentucky Geological Survey is conducting research to determine the resource potential of below-drainage coal in the Eastern Kentucky Coal Field (Kentucky Geological Survey 2002e).

Coal resource estimates refer to the geologic or regional occurrence of coal. The primary factors for these determinations are correlation (accurate identification of beds), coal bed extent, and thickness. Coal seams less than 14 inches thick are excluded from resource estimation.

Coal reserves on the other hand, apply to that part of the resource that is technically and economically recoverable under prevailing market conditions. Some technical considerations are the character of the roof rock, mining methods, seam thickness and variation, coal inclination, interruption of coal by channels or cut-offs, and quality of coal. Since the detailed data required for reserve estimates were not available, this environmental impact statement relies on resource estimates. These are based on the correlation of coal beds, bed extent, and thickness, and provide a general knowledge of the occurrence and trends of as many coal beds, as data were obtainable. Data from the 1981 Energy Resource Series was used and updated to the present by subtracting 1981-2001 coal production from 1981 data on the 22 counties included in the DBNF.

In 1981, 10.9 percent of the remaining resources identified in DBNF counties were estimated to be located on DBNF lands (surface) (Table 3 - 18). This number was generated from all coal resources within the listed DBNF counties. It represents an estimate of coal resources based on the percent of National Forest System land in the selected counties. This does not take into account any mineral ownership considerations but considers only undifferentiated DBNF lands (surface).

As shown in Table 3 - 18, the Forest Service owns 18.3 percent of the coal rights on the DBNF. In 1981, federal ownership extended to 328.5 tons of the 1795 million tons of coal resource on the Forest. More recent information contained in the table shows that 320 million tons of federally owned coal remained on the DBNF in 2002. Land use restrictions and practical considerations will reduce the amount of coal resources available for development, however. Restrictions include the prohibition of surface mining on the DBNF. In any case, an estimate of “actual coal resources available” is beyond the scope of this report.

The Redbird district contains the most coal resources on the DBNF. The three Redbird counties (Clay, Leslie, and Owsley) had an estimated 201.0 million tons of remaining coal resources in 2002. Whitley and McCreary counties in the Stearns district also have high coal potential. Data included in Table 3 - 18 indicates that 57 million tons of coal resources remained in these counties in 2002. These two areas on the DBNF, the Redbird District plus Whitley and McCreary counties, represent about 258 million tons, or 81 percent of the total federal coal resources on the DBNF.

Application of the Unsuitability Criteria

The Surface Mining Control and Reclamation Act of 1977 (SMCRA 1977) prohibit the mining of coal by surface methods on National Forest System lands east of the 100th meridian (located in central Texas). Therefore, all coal development on Federal coal rights on the DBNF in eastern Kentucky must employ underground methods.

The requirements for federal coal land management are outlined in 43 CFR 3400 and administered by the Bureau of Land Management. Federal coal lands that authorize surface coal mining operations must be assessed using the Unsuitability Criteria found in 43 CFR 3461. Under these criteria, when federal lands are evaluated for their suitability for a coal mining lease, if the mining is to done by the underground methods and there will be no “surface coal mining operations” upon the surface of federal lands, the lands shall not be assessed as unsuitable. A ruling published on December 17, 1999, stated, “Subsidence due to underground coal mining is not included in the definition of surface coal mining operations…” This interpretation was remanded in court, appealed and re-instated so that surface effects from subsidence are not included in the definition of “surface coal mining operations.” Since federal statutes allow only underground mining on the DBNF, the unsuitability criteria is not applicable to these federal lands.

Table 3 - 18. Coal Resource Estimate.

DBNF Counties north to south	FS Acreage	Total acres/ County	Calculated % FS(SO)[1]	Total Orig. Coal[2]	Remaining ('81)[3]	Production 1981 to 2002	Undergrd	Remaining (2002)	Est % FS(SO)	Remaining (2002) FS Redbird[4]	Remain. (2002) FS McCr/Whit.	Remain. (2002) FS All
Rowan	62,509	179,200	34.9	na		0			0.3488			
Bath	19,300	178,560	10.8	na		0			0.1081			
Menifee	46,622	129,920	35.5	10.53	9.7	0		9.7	0.3589			3.48
Morgan	12,948	243,840	5.3	849.4	824.87	2.9	y	821.97	0.0531			43.65
Powell	15,528	115,200	12.7	0.76	0.72	0		0.72	0.1348			0.10
Wolfe	16,458	142,080	11.2	443.92	438.25	4.3	n	433.95	0.1158			50.25
Estill	5,598	162,560	3.4	2.5	2.49	0		2.49	0.0344			0.09
Lee	8,587	133,760	6.4	364	351	1.9	n	349.1	0.0642			22.41
Jackson	58,375	221,440	26.3	375.9	359.3	2.9	*y	356.4	0.2636			93.95
Owsley	16,280	126,720	12.8	574	565	5.1	n	559.9	0.1285	71.95		71.95
Rockcastle	14,793	202,880	7.3	144.5	135.3	1.3	*y	134	0.0729			9.77
Laurel	62,478	278,400	22.4	408	352.7	8	y	344.7	0.2244			77.35
Pulaski	37,441	423,040	8.7	153	122	3.1	y	118.9	0.0885			10.52
Wayne	642	293,760	0.22	27.3	21.6	3.3	y	18.3	0.0022			0.04
McCreary	142,122	273,280	51.3	445	347.6	6.69	y	340.91	0.5201		177.31	177.31
Whitley	45,365	281,600	15.5	975.5	853	28.93	y	824.07	0.1611		132.76	132.76
Clay	77,594	301,440	25.7	1,536.11	1,457.60	20.92	y	1,436.68	0.2574	369.80		369.80
Leslie	52,194	258,560	20.1	3554.65	3380.41	127.68	y	3252.73	0.2019	656.73		656.73
Perry	2,191	218,880	1.0	3,596.70	2,925	170.41	y	2,755	0.01			27.55
Letcher	0	216,960	0.4	3105.93	2416.36	134.74	y	2281.62	0			0.00
Harlan	803	298,880	0.27	645.97	642.7	211.48	y	431.22	0.0027			1.16
Knox	74	247,680	0.0003	1,381.90	1,280	20.81	y	1,259	0.0003			0.38
Totals	697,902	4928640		17059.46	16485.6	754.46		15731.14		1098.47	310.06	1749.23

Bureau of Land Management, Jackson Field Office, 8/19/2002

[1]% of County in FS surface ownership (from USDA Forest Service data and county areas data)

[2]In millions of short tons

[3]From Energy Resources Series, 1981 data

[4](Remaining) x % FS

DBNF Coal Resource Estimate (2002)

1749 x .183 (Fed. coal rights) = 320 million tons

Redbird: 1098 x .183 (Fed. coal rights) = 201million tons

McCreary/Whitley counties: 310 x .183

(Fed. coal rights) = 57 million tons (total of two areas = 258)

81% (258/320) of Federal coal resources are in Redbird District and McCreary/Whitley County areas

Environmental Effects

AREA OF ANALYSIS

The area with the DBNF proclamation boundary constitutes the area of analysis for the environmental effects discussion for the minerals resource. The direct and indirect effect of implementing the 2004 Forest Plan will be limited to impacts that effect National Forest System lands. The cumulative effects analysis, however, will include impacts from activities off National Forest System lands and the impact they have on the indicators listed below.

The indicators to be used for this analysis are:

- Number of National Forest System acres available for lease
- Stipulations of mineral leasing applied by alternative.

INDICATOR EXPLANATION

The special lease stipulations mentioned above and discussed below are provisions that modify standard lease rights and are attached to, and made a part of, a new lease. Special stipulations provide for greater protection of identified resources as well as mitigation of negative effects.

Lease Notice (LN)

A Lease Notice provides more detailed information concerning limitations that already exist in law, lease terms, regulations, or operational orders. An LN also addresses special items the lessee should consider when planning operations but does not impose new or additional restrictions. (Lease Notices attached to leases should not be confused with Notices to Lessees.)

Notices to Lessees (NTL)

Notices to Lessees implement regulations and operating orders and serve as instructions on specific items of importance within a specified area.

Controlled Surface Use (CSU)

Under the Controlled Surface Use stipulation, use and occupancy are allowed (unless restricted by another stipulation), but certain resource values may require special operational constraints that modify leasing rights. CSU stipulations identify standards that operators must meet to mitigate potential adverse effects to surface resources. Such stipulations permit year-round occupancy and accessibility to leased lands. Discovery and development of oil and gas resources proceed under restrictions that mitigate impacts to other resources. Compliance with CSU stipulations may require more decision-making responsibility when surface-disturbing activities are proposed.
CSU compliance could increase the cost of oil and gas activities by requiring use of expensive technology to meet mitigation requirements. The use of Controlled Surface Use stipulations meets Forest Service mineral policy direction.

Timing Limitation Stipulation (TL) (Seasonal Restriction)

A Timing Limitation Stipulation prohibits surface use at specific times to protect identified resource values. TLs do not apply to the operation and maintenance of production facilities unless the findings of analysis demonstrate a continued need for mitigation that less stringent, project-specific measures cannot accomplish.

TLs are used when necessary to restrict exploration activities on leased lands for a period longer than 60 days. TLs also provide accessibility for a portion of the year while maintaining the potential for discovery and utilization of oil and gas resources. TLs may increase exploration costs by narrowing the window available for drilling. Use of TLs must conform to the Forest Service's national mineral policy.

TLs could increase development costs if a well is not completed within time limits. Shutting a drilling operation down and leaving the equipment idle or moving the equipment to another site and then moving it back increases costs. When a drilling proposal is submitted, on-the-ground conditions may allow an exemption or require an extension of timing limitations based on seasonal conditions or habitat use.

No Surface Occupancy (NSO)

Use or occupancy of the land surface for fluid mineral exploration or development is prohibited under this stipulation to protect identified resource values. Leasing with an NSO stipulation is an alternative to declaring an area "administratively unavailable" for leasing. Even though an NSO stipulation prohibits surface occupation for exploration or development of oil and gas, these subsurface resources remain legally available if they can be accessed by other means. An NSO lease may allow development through directional drilling if lands adjacent are available for leasing with surface occupancy or are privately owned. Technology limits the distance a well's surface location can be placed from the downhole location, and in some areas, any directional drilling is technically impossible. Also, directionally drilled wells are more costly to drill and to maintain and reach the end of their economic life sooner than vertically drilled wells. While drilling and production may be more costly, leasing with NSO does offer opportunities for exploration and development of resources that would otherwise be unavailable. Leasing with No Surface Occupancy, therefore, meets Forest Service minerals policy direction.

Statutorily Withdrawn (WD)

Federal minerals are not available for leasing due to law or statute enacted by Congress.

RESOURCE TABLES

Figure 3 - 18. Oil/Gas Projections for the Next Two Decades.

Total Wells per Decade	Fed Leasing Decision and Well Construction		Private Minerals on the DBNF		Off-Forest Wells*	
Alt.	Decade 1	Decade 2	Decade 1	Decade 2	Decade 1	Decade 2
A	35	23	100	65	3050	3250
B-1	0	0	75	50	3050	3250
C	40	25	120	75	3050	3250
C-1	40	25	120	75	3050	3250
D	40	25	120	75	3050	3250
E	60	38	150	90	3050	3250

*Considers development in eastern Kentucky

Figure 3 - 19. Oil/Gas Projections Annually.

Annual wells	Fed Leasing Decision and Well Construction		Private Minerals on the DBNF		Off-Forest Wells*	
Alt.	Decade 1	Decade 2	Decade 1	Decade 2	Decade 1	Decade 2
A	3.5	4.6	10	6.5	305	325
B-1	0	0	7.5	5	305	325
C	4	5	12	7.5	305	325
C-1	4	5	12	7.5	305	325
D	4	5	12	7.5	305	325
E	6	7.6	15	9	305	325

*Considers development in eastern Kentucky

Work to develop wells on the Forest will primarily take place in the 1.K, 1.M, 4.A, and 4.B prescription areas on the Stearns and Redbird ranger districts. The 4.A Timber Production Prescription Area of Alternative E-1 would hold the greatest potential for mineral development. About 11 acres scattered throughout in this prescription area's 396,000 acres would likely be disturbed for this purpose. The number of acres that would potentially be disturbed by drilling operations under the various alternatives are:

Figure 3 - 20. Potential Surface Disturbance Annually.

Alt.	Acres for Federal Min.	Acres for Private Min.	Acres Off-Forest
A	4.4	22	88
B-1	0	16.5	88
C	6.6	26.4	88
C-1	6.6	26.4	88
D	6.6	26.4	88
E-1	11	33	88

The numbers for Figure 3 - 20 were generated using the assumptions that roads to access well pads on the DBNF generally will not exceed a half-mile and that one-mile of road access for well development equals about 2.4 acres of disturbance.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Private owners are free to develop reserved and outstanding minerals on the Forest based on valid existing rights, severance deed rights, state and federal laws, the Secretary of Agriculture's Rules and Regulations (for reserved mineral rights only) and an approved plan of operations. Private mineral activity often influences federal mineral development. Private mineral developers may find trends for oil and gas fields that appear to occur among federal minerals. If so, they may choose to initiate an exploration project or pursue drilling on National Forest System lands. Deep mining of coal also influences development of federal coal as well. With the mixed ownership pattern of both surface and mineral rights on the DBNF, the development of privately owned coal may take place adjacent to federal coal.

Direct effects immediately follow a specific action or activity and occur at the same place. Leasing itself would not cause direct effects, though it is reasonable to expect direct effects to result from subsequent exploration and development. These effects on lands and resources were analyzed assuming reasonably foreseeable development activities.

Indirect effects are caused by a specific action or activity but typically occur later in time and farther in distance. Indirect effects on lands and resources were analyzed for the alternatives. Direct and indirect effects were sometimes considered together and not specifically identified or disclosed separately.

The designation of acres as available for oil and gas leasing does not cause a direct effect to those acres. That decision only authorizes the BLM to issue leases for those acres under standard lease terms and subject to additional constraints.

Prescription Area 1.C, Cliffline Community – No Surface Occupancy/ Controlled Surface Use

This Prescription Area is an area that runs from 100 feet above the cliffline to 200 feet below the cliffline. The No Surface Occupancy stipulation applies to the above-cliffline zone, while the below-cliffline zone is protected by the Controlled Surface Use stipulation.

The hydrologic condition of cliffline habitat is a key component of this ecosystem. The No Surface Occupancy stipulation is intended to prevent subsurface as well as surface disturbance. Some activities are permitted in the below-cliffline zone, but only if they pose no threat to PETS species and do not adversely impact the long-term integrity of cliffline habitat. Road construction for geophysical uses is prohibited in this prescription area.

Prescription Area 1.G, Rare Communities – No Surface Occupancy & Controlled Surface Use

Minerals management is allowed in these areas under the No Surface Occupancy stipulation in the Rare Community *Site*; in the remainder of the prescription area (the Rare Community Management *Zone*), the Controlled Surface Use stipulation protects the integrity of rare community habitat. Rare communities on the DBNF are often natural wetlands or the ecosystem associated with natural wetlands. These areas are to be noted during pre-construction field visits and avoided to protect rare community sites. A minimum 100-foot buffer from the outer edge of the wetland ecosystem is recommended. A buffer determined at the project level may also protect other rare community sites.

Prescription Area 1.I, Old-Growth – Controlled Surface Use

Old-growth communities will be protected by the Controlled Surface Use stipulation, which allows only one percent of area identified as old-growth to be disturbed for mineral leasing over the life of the Forest Plan.

For example, only three surface acres of an old-growth area 300 acres in size may be for mineral lease purposes. Should one-half acre be used for a development in the first year, only 2.5 acres would be available for disturbance afterward.

Access

Access to federal minerals within the DBNF will be affected to some degree by leasing stipulations. No Surface Occupancy relegates mineral developments to locations where they will not interfere with ecosystem management goals. However, such locations may not be advantageous for mineral development. Natural conditions as well as administrative restrictions can render mineral development unprofitable. Directional drilling has not been used on the DBNF because local conditions generally make investing in this technology unprofitable.

Availability of Mineral Resources

Coal operations (underground mining) will be largely unaffected by restrictions in any alternative. Areas unavailable for leasing, such as developed recreational areas and wilderness areas, generally are small and avoiding them should pose no problem. In any case, such areas often have little potential for coal development. Since coal will be developed only by underground methods, prescription area standards for surface resources will have little effect on coal mine development.

Oil and gas resources also remain available, but as mentioned earlier, the impact of lease stipulations on oil and gas operations are far more significant. Surface occupancy helps reduce costs and provides a wider range of access opportunities. Surface occupancy restrictions can so limit the space available for operations that development becomes unprofitable.

CUMULATIVE EFFECTS (COMMON TO ALL ALTERNATIVES)

The only cumulative effects anticipated from mineral exploration and development on the DBNF over the next 10 years would be associated with oil and gas development. The BLM's Reasonably Foreseeable Development Scenario projects that approximately four oil and/or gas wells will be drilled on the Forest annually to recovery federally owned minerals. Three of these will likely be commercially productive. Sites resulting in dry holes would be totally reclaimed. For each of the three producing well sites, the area needed for production would be less than was required for the drilling phase. There would be a residual of two disturbed acres for each new producing well, one acre for the access road and another acre for the pump jack and ancillary tanks or pipelines. (Drill pad size would decrease from one acre to about a half acre with the unneeded portion being reclaimed.) With two acres of disturbed area per new producing well created each year, 60 acres of developed land would remain from these activities over the 10-year planning period.
When looking at potential cumulative impacts to air quality, water quality (hydrology), aquatic habitat, wildlife, threatened and endangered species, soils, and visual qualities over the life of this plan, the impacts should be negligible.

The positive economic impacts resulting from oil and gas exploration and development should also be taken into account. Lessees/operators usually contract locally for road and drill pad construction. They purchase food, fuel, lodging, and other supplies from local sources and may subcontract certain parts of the operation to local well servicing companies. Most of the salaries paid to workers are spent in the local area. The estimated dollars that an average drill rig generates per day is over $200 per worker. A typical well drilling operation will have an average of 10 workers. This translates into about $2,000 per day spent in the local area. Since the average well in Kentucky takes 5-7 days to complete, $10,000 to $14,000 per well would be pumped into the local economy.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Table 3 - 19. Surface Mineral Stipulations by Prescription Area for Alterative A.

PRESCRIPTION AREA	Acres[1]	Acres of Federal Minerals	Stipulation
1.A Research Natural Areas	658	0	NSO
1.C. Cliffline Community	111,205	28,312	NSO
1.E. Riparian Corridor	155,379	55,263	N/A
1.G. Rare Community (Estimate)	1,200	257	N/A
1.I. Designated Old-Growth	15,300	N/A	N/A
1.J. Significant Bat Caves	6,115	1,359	NSO
2.A. Clifty Wilderness	12,646	3,189	WD
2.B. Beaver Creek Wilderness	4,791	3,444	WD
3.A. Developed Recreation	3,700	0	NSO
3.B. Large Reservoirs	30,673	19,836	NSO
3.C. Wild & Scenic Rivers	15,173	4,837	NSO
3.E. Red River Gorge Geological Area	16,042	7,548	NSO
3.F. Natural Arch Scenic Area	1,065	608	NSO
3.H.1. Ruffed Grouse Emphasis	10,535	1,856	LN
4.B General Forest Area	568,206	201,536	LN
5.A. Communications Sites	20	0	NSO
5.C. Source Water Protection	34,015	3,511/7,208	N/A

[1]These acreage totals may overlap with other prescription areas. The oil and gas leasing stipulations apply to Federal minerals within these prescription areas.

CSU = Controlled Surface Use, LN = Lease Notice, NSO = No Surface Occupancy,

WD = Statutorily Withdrawn, N/A = Not Applicable.

Under Alternative A, approximately 85 percent of the federal minerals on the DBNF would be available for leasing. The 1985 Plan, represented by Alternative A, included a management area known as General Forest that was generally available for mineral leasing.

Under Alternative A, identification and analysis of impacts would mostly take place at the project level. Wilderness areas as well scenic areas near developed recreation areas would be protected from surface occupancy. At the Forest Plan level of analysis, this alternative would offer nominal surface occupancy restriction for mineral development, which could lead to inconsistencies in mitigating the impacts of specific projects. In the above table, areas identified as “N/A” are not applicable because these prescription areas were not part of the 1985 Plan. There could be an increased workload at the project level to analyze projects to include many concerns that the other alternatives have addressed through the creation of prescription areas. A large number of acres would remain available for lease, but efforts to maintain species viability and protect other resources while exploring for and developing minerals would all be incorporated in project analyses. Over time, this could lead to major delays in processing lease proposals.

CUMULATIVE EFFECTS OF ALTERNATIVE A

A large number of acres would remain available for lease under this alternative. The cumulative effects of this alternative would be minimal in relation to the amount of acres available for lease or the lease stipulations applied.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Alternative B-1, the alternative that emphasizes custodial management, would preclude surface occupancy for mineral development on most of the Forest (Table 3 - 20). Underground mining could take place under the same suitability criteria that would apply to all alternatives.

Table 3 - 20. Surface Mineral Stipulations by Prescription Area for Alterative B-1.

PRESCRIPTION AREA	Acres[1]	Acres of Federal Minerals	Stipulation
1.A Research Natural Areas	658	0	NSO
1.C. Cliffline Community	111,205	28,312	NSO
1.E. Riparian Corridor	155,379	55,263	NSO
1.G. Rare Community (Estimate)	1,200	257	NSO
1.I. Designated Old-Growth	15,300	N/A	N/A
1.J. Significant Bat Caves	6,115	1,359	NSO
1.M. Custodial Area	394,163	133,938	NSO
2.A. Clifty Wilderness	12,646	3,189	WD
2.B. Beaver Creek Wilderness	4,791	3,444	WD
2.C. Wilderness Study Area	2,834	350	NSO
3.A. Developed Recreation	3,700	0	NSO
3.B. Large Reservoirs	30,673	19,836	NSO
3.C. Wild & Scenic Rivers	15,173	4,837	NSO
3.E. Red River Gorge Geological Area	16,042	7,548	NSO
3.F. Natural Arch Scenic Area	1,065	608	NSO
3.H.1. Ruffed Grouse Emphasis	10,535	1,856	N/A
5.A. Communications Sites	20	0	NSO
5.C. Source Water Protection	34,015	10,719	NSO

[1]These acreage totals may overlap with other prescription areas. The oil and gas leasing stipulations apply to Federal minerals within these prescription areas.

CSU = Controlled Surface Use, NSO = No Surface Occupancy,

WD = Statutorily Withdrawn, N/A = Not Applicable.

To accomplish its goals, this alternative would place the No Surface Occupancy (NSO) stipulation on federal mineral development in all but two of its prescription areas. The two Wilderness Areas would be classified as Statutorily Withdrawn. Only in cases of national emergency or national security could the NSO stipulation be revisited under this alternative. Alternative B-1 would also increase costs for those seeking to develop privately owned oil and gas resources on the Forest. Directional drilling has seldom been used in this area and the unfavorable cost/benefit ratio would render its use unlikely. The development of federally owned oil and gas resources would be significantly reduced. There might be some opportunities for coal development via underground mining methods, but even minimal subsidence would not be allowed.

This alternative could also hinder the treatment of areas in need of reclamation from past mineral projects that the Forest Service has acquired for that purpose. Impacts from these unreclaimed areas would remain with no plans made to deal with them. The goal of this alternative would be to remove new human influences and let natural processes shape the Forest environment.

CUMULATIVE EFFECTS OF ALTERNATIVE B-1

This alternative would limit oil and gas development. Access to areas of interest for exploration or development of mineral resources would become more difficult even if adjacent private lands indicated some potential on the DBNF. Reduced exploration and operations might cause some, but not great, negative impact to some local economies.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

Alternative C would focus primarily on ecosystem management. Forest management activities would concentrate on the protection or enhancement of Forest ecosystems, especially habitat for PETS species. Multiple uses of Forest resources would occur in this context.

Table 3 - 21. Surface Mineral Stipulations by Prescription Area for Alterative C.

PRESCRIPTION AREA	Acres[1]	Acres of Federal Minerals	Stipulation
1.A Research Natural Areas	658	0	NSO
1.C. Cliffline Community	111,205	28,312	NSO/CSU[2]
1.E. Riparian Corridor	155,379	55,263	CSU
1.G. Rare Community (Estimate)	1,200	257	NSO/CSU[3]
1.I. Designated Old-Growth	15,300	N/A	CSU
1.J. Significant Bat Caves	6,115	1,359	NSO
1.K. Habitat Diversity Emphasis	386,577	124,403	LN
2.A. Clifty Wilderness	12,646	3,189	WD
2.B. Beaver Creek Wilderness	4,791	3,444	WD
3.A. Developed Recreation	3,700	0	NSO
3.B. Large Reservoirs	30,673	19,836	NSO
3.C. Wild & Scenic Rivers	15,173	4,837	NSO
3.E. Red River Gorge Geological Area	16,042	7,548	NSO
3.F. Natural Arch Scenic Area	1,065	608	NSO
3.H.1. Ruffed Grouse Emphasis	10,535	1,856	N/A
5.A. Communications Sites	20	0	NSO
5.C. Source Water Protection	34,015	3,511/7,208	NSO/CSU[4]

[1]These acreage totals may overlap with other prescription areas. The oil and gas leasing stipulations apply to Federal minerals within these prescription areas.
[2]NSO above and CSU below the cliffline
[3]NSO on RC site; CSU in remainder of RC management zone
[4]Zone 1 (NSO); Zone 2 (CSU)
CSU = Controlled Surface Use, LN = Lease Notice, NSO = No Surface Occupancy,
WD = Statutorily Withdrawn, N/A = Not Applicable

Federal minerals would be available for lease under this alternative, but many acres would be subject to stipulations designed to protect other Forest resources, especially ecosystem health and habitat for PETS species. The reduced acreage available for non-stipulated leasing for oil and gas development would limit access and increase costs that would eventually be passed on to consumers. Most areas where the No Surface Occupancy stipulation would be applied would be localized, however, and most projects could work around areas of concern but at greater cost. In the eastern portion of the Forest, such as the Redbird District, restrictions placed on riparian areas would leave fewer opportunities for mineral development. The steep slopes of many remaining areas would make erosion control difficult and increase the likelihood of sediment entering streams.

CUMULATIVE EFFECTS OF ALTERNATIVE C

There should be no cumulative effects from implementation of this alternative.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

Alternative C-1 would emphasize ecosystem management with an added focus on recreation. Many acres would be subject to stipulations to protect ecosystems and other Forest resources. The NSO or CSU stipulations would be applied where appropriate. The CSU stipulation would allow mineral development as long as its protective restrictions were met.

Table 3 - 22. Surface Mineral Stipulations by Prescription Area for Alterative C-1.

PRESCRIPTION AREA	Acres[1]	Acres of Federal Minerals	Stipulation
1.A Research Natural Areas	658	0	NSO
1.C. Cliffline Community	111,205	28,312	NSO/CSU[2]
1.E. Riparian Corridor	155,379	55,263	CSU
1.G. Rare Community (Estimate)	1,200	257	NSO/CSU[3]
1.I. Designated Old-Growth	15,300	N/A	CSU
1.J. Significant Bat Caves	6,115	1,359	NSO
1.K. Habitat Diversity Emphasis	386,577	124,403	LN
2.A. Clifty Wilderness	12,646	3,189	WD
2.B. Beaver Creek Wilderness	4,791	3,444	WD
3.A. Developed Recreation	3,700	0	NSO
3.B. Large Reservoirs	30,673	19,836	NSO
3.C. Wild & Scenic Rivers	15,173	4,837	NSO
3.E. Red River Gorge Geological Area	16,042	7,548	NSO
3.F. Natural Arch Scenic Area	1,065	608	NSO
3.H.1. Ruffed Grouse Emphasis	10,535	1,856	LN
5.A. Communications Sites	20	0	NSO
5.C. Source Water Protection	34,015	3,511/7,208	NSO/CSU[4]

[1]These acreage totals may overlap with other prescription areas. The oil and gas leasing stipulations apply to Federal minerals within these prescription areas.

[2]NSO above and CSU below the cliffline

[3]NSO on RC site; CSU in remainder of RC management zone

[4]Zone 1 (NSO); Zone 2 (CSU)

CSU = Controlled Surface Use, LN = Lease Notice, NSO = No Surface Occupancy,

WD = Statutorily Withdrawn, N/A = Not Applicable

CUMULATIVE EFFECTS OF ALTERNATIVE C-1

There should be no cumulative effects from implementation of this alternative.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

The recreation emphasis of Alternative D would provide opportunities for mineral leasing while mitigating impacts to surface resources. Legal constraints for protection of species and habitat would be in place and all project-level analysis would seek to meet these goals. Under this alternative management would seek to improve or provide expanded recreational opportunities for the public. In achieving this, opportunities for mineral development would likely occur, especially for oil and gas development. Surface occupancy would be available in more areas, and the creation of new access for additional recreation development would likely create new areas for mineral development also.

Table 3 - 23. Surface Mineral Stipulations by Prescription Area for Alterative D.

PRESCRIPTION AREA	Acres[1]	Acres of Federal Minerals	Stipulation
1.A Research Natural Areas	658	0	NSO
1.C. Cliffline Community	111,205	28,312	NSO/CSU[2]
1.E. Riparian Corridor	155,379	55,263	CSU
1.G. Rare Community (Estimate)	1,200	257	NSO/CSU[3]
1.I. Designated Old-Growth	15,300	N/A	CSU
1.J. Significant Bat Caves	6,115	1,359	NSO
1.K. Habitat Diversity Emphasis	386,577	124,403	LN
2.A. Clifty Wilderness	12,646	3,189	WD
2.B. Beaver Creek Wilderness	4,791	3,444	WD
3.A. Developed Recreation	3,700	0	NSO
3.B. Large Reservoirs	30,673	19,836	NSO
3.C. Wild & Scenic Rivers	15,173	4,837	NSO
3.E. Red River Gorge Geological Area	16,042	7,548	NSO
3.F. Natural Arch Scenic Area	1,065	608	NSO
3.H.1. Ruffed Grouse Emphasis	10,535	1,856	LN
5.A. Communications Sites	20	0	NSO
5.C. Source Water Protection	34,015	3,511/7,208	NSO/CSU[4]

[1]These acreage totals may overlap with other prescription areas. The oil and gas leasing stipulations apply to Federal minerals within these prescription areas.

[2]NSO above and CSU below the cliffline

[3]NSO on RC site; CSU in remainder of RC management zone

[4]Zone 1 (NSO); Zone 2 (CSU)

CSU = Controlled Surface Use, LN = Lease Notice, NSO = No Surface Occupancy,

WD = Statutorily Withdrawn, N/A = Not Applicable

CUMULATIVE EFFECTS OF ALTERNATIVE D

There should be no cumulative effects from implementation of this alternative.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the production of goods and services to benefit the public. The Forest would take proactive measures to make mineral leasing opportunities available to boost employment locally as well as benefit the regional as well as the national economy.

One goal of Alternative E-1 would be meeting the demand for domestic minerals production. The Forest would actively encourage industry to develop federal minerals. Following recent trends in coalmine development, local economies in the Redbird and Stearns Districts would benefit most. Opportunities for oil and gas development would increase on all four southern districts, however. Surface disturbance associated with deep mining would increase sedimentation. Although these effects would generally be felt off National Forest System lands, they are still impacts to be taken into account. Short-term impacts would be associated with well pad development. Generally, the disturbance from well pad construction is small, and vegetation is not difficult to re-establish. New access roads to facilitate development could create problems if not adequately maintained.

Table 3 - 24. Surface Mineral Stipulations by Prescription Area for Alterative E-1.

PRESCRIPTION AREA	Acres[1]	Acres of Federal Minerals	Stipulation
1.A Research Natural Areas	658	0	NSO
1.C. Cliffline Community	111,205	28,312	NSO/CSU[2]
1.E. Riparian Corridor	155,379	55,263	CSU
1.G. Rare Community (Estimate)	1,200	257	NSO/CSU[3]
1.I. Designated Old-Growth	15,300	N/A	CSU
1.J. Significant Bat Caves	6,115	1,359	NSO
1.K. Habitat Diversity Emphasis	386,577	124,403	LN
2.A. Clifty Wilderness	12,646	3,189	WD
2.B. Beaver Creek Wilderness	4,791	3,444	WD
3.A. Developed Recreation	3,700	0	NSO
3.B. Large Reservoirs	30,673	19,836	NSO
3.C. Wild & Scenic Rivers	15,173	4,837	NSO
3.E. Red River Gorge Geological Area	16,042	7,548	NSO
3.F. Natural Arch Scenic Area	1,065	608	NSO
3.H.1. Ruffed Grouse Emphasis	10,535	1,856	LN
4.A. Timber Emphasis	369,697	135,122	CSU
5.A. Communications Sites	20	0	NSO
5.C. Source Water Protection	34,015	3,511/7,208	NSO/CSU[4]

[1]These acreage totals may overlap with other prescription areas. The oil and gas leasing stipulations apply to Federal minerals within these prescription areas.
[2]NSO above and CSU below the cliffline
[3]NSO on RC site; CSU in remainder of RC management zone
[4]Zone 1 (NSO); Zone 2 (CSU)
CSU = Controlled Surface Use, LN = Lease Notice, NSO = No Surface Occupancy,
WD = Statutorily Withdrawn, N/A = Not Applicable

CUMULATIVE EFFECTS OF ALTERNATIVE E-1

There should be no cumulative effects from implementation of this alternative.

Biological Elements

OLD-GROWTH

Affected Environment

The Forest Service, Southern Region, recognizes old-growth forests as a valuable natural resource worthy of protection, restoration, and management. In 1989, then-Forest Service Chief Dale Robertson issued a national position statement on old-growth forests (USDA Forest Service 1989a, 1997b). He provided this definition:

> Old-growth forests are ecosystems distinguished by old trees and related structural attributes. Old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulation of large wood material, number of canopy layers, species composition, and ecosystem function.
>
> The age at which old-growth develops and the specific structural attributes that characterize old-growth will vary widely according to forest type, climate, site conditions, and disturbance regime. Old-growth in fire-dependent forest types may not differ from younger forests in the number of canopy layers or accumulation of down woody material. However, old-growth is typically distinguished from younger growth by several of the following attributes:
>
> 1) Large trees for the species and site
> 2) Wide variation in tree sizes and spacing
> 3) Accumulations of large-sized dead standing and fallen trees that are high relative to earlier stages
> 4) Decadence in the form of broken or deformed tops or boles and root decay
> 5) Multiple canopy layers
> 6) Canopy gaps and understory patchiness.

Old-growth forests provide a variety of values, such as: biological diversity, wildlife habitat, recreation, aesthetics, soil productivity, water quality, aquatic habitat, and cultural values as well as high-value timber products on a small scale. According to Hunter (1989), it is probably neither possible nor desirable to craft a universal definition of old-growth.

Old-growth communities are rare or largely absent in the southeastern forests of the United States. Only about 0.5 percent of the total forest acreage in the southeast (approximately 108.4 million acres) is currently old-growth (Davis 1996 in USDA Forest Service 1997b). Within its nearly 700,000-acre land base, the DBNF has about 2,000 acres of trees older than 150 years, but less than 1,000 acres of trees older than 200 years, according to the Continuous Inventory of Stand Condition (CISC). Currently, none is managed for old-growth attributes. For these reasons, the DBNF is addressing the restoration of this portion of the southern forest ecosystem. Decisions made regarding old-growth during Plan revision are based on ecological principles, social values, and legal requirements.

Current federal laws and regulations governing National Forests do not specifically mandate management for old-growth conditions. However, various laws do provide direction to the Forest Service for:

- Management of multiple natural resources and values
- Protection and recovery of PETS species
- Provision of habitats to sustain viable populations of native plants and animals
- Maintaining and enhancing the diversity of plant and animal communities.

These concerns can be addressed in part by establishing and maintaining a network of old-growth across National Forest System lands.

As opposed to merely an area of "old trees," an area of functional old-growth is generally understood to be an area of ecological integrity. Old trees are only one biotic component of the old-growth condition, and functionality is scale-dependent. The larger the area, the more likely that species requiring interior habitat rather than edge habitat will be present. Additionally, an area must be of a minimal size, with some minimum width to minimize edge effect and maximize substantial interior that will buffer outside influences. (A circle or octagon is better than a long, narrow strip.) As a result, the area may be more resilient to environmental events such as windstorms, insect and disease outbreaks, and fire. The larger the area, the more likely old-growth conditions will persist after disturbance with most of its distinguishing characteristics and vegetative layers intact. However, for even moderate resiliency to insect and disease infestation, an area may need to be tens of thousands of acres in size. The DBNF suggests that an area must be no smaller than 300 acres in size to be considered as functional old-growth (Martin 1992).

Some species require older, large, live trees for part of their life cycle. One species on the DBNF, the sixbanded longhorn beetle, appears to be old-growth-dependent. This insect requires large decadent beech and sugar maples for its larval stage. Whether this species requires functional old-growth or just patches of old trees is unclear, however. Old-growth may provide habitat for species that remain unidentified. Additionally, species not now appearing in this area could colonize this habitat, or begin to express them in a visible manner, once old-growth is established.

Thus, the concept of old-growth encompasses more than the presence of "old" trees. Different forest communities reach old-growth conditions at different ages, under different disturbance regimes, and via different management strategies. The DBNF has identified eight major old-growth communities based on the report, Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region (USDA Forest Service 1997b). To be identified as old-growth, a stand must meet the following four criteria. Three are detailed in Table 3 - 25.

- Minimum age of the oldest existing age class
- Minimum basal area
- Minimum diameter at breast height (DBH) of the largest trees in the stand
- Disturbance history.

To address social concerns brought out by the public, areas to be considered should have minimal evidence of past human disturbance. However, recent management activities that are not inconsistent with old-growth, including prescribed burning, some silvicultural practices, and trail maintenance might not disqualify a stand from management as old-growth.

Table 3 - 25. Three of the four qualifying criteria for old-growth on the DBNF.[1]

Community	Minimum age of the oldest existing age class (years)	Minimum basal area (sq. ft/acre)	DBH of largest trees (inches)
Conifer-northern hardwood forest	140	40	≥20
Mixed mesophytic forest	140[2]	40	≥30
River floodplain hardwood forest	100	40	≥16
Dry-mesic oak forest and woodland	130[2]	40	≥20
Dry and xeric oak forest, woodland, wooded grassland/shrubland	110[2]	10	≥16
Xeric yellow pine and yellow pine-oak forest woodland and wooded grassland/shrubland	100	20	≥10
Dry and dry-mesic oak-yellow pine forest and woodland	120[2]	40	≥19
Eastern riverfront forest	100[2]	40	≥25

[1] Criterian 4 is disturbance history. Criteria adapted from USDA Forest Service 1997b.

The existence on the DBNF of old-growth, based on the sum of criteria in Table 3 - 25, has not been confirmed through field inventories, although some stands meet the age criterion. The DBNF did not manage any areas specifically for old-growth conditions under the 1985 Plan. However, *future* old-growth and/or *possible* old-growth stands were identified.

Future old-growth (FOG) consists of any Prescription Area managed in such a way that old-growth characteristics will tend to prevail in the future and across a large spatial scale. These areas may include: Research Natural Areas, Wilderness areas, Wild & Scenic River corridors, Red River Gorge, Natural Arch Scenic Area, Cliffline corridor, Significant bat cave areas, Riparian corridor, and Source water protection areas (300 ft. zone). In these locations, few improvements exist or are planned, and vegetation management is limited primarily to benefit habitat or to improve the condition for which the area was established. Manipulation in these areas is limited. Stands of trees will likely not be harvested, a wide range of tree sizes may exist, snags and logs often remain, soil compaction is minimized, interior-dependent species may use the area, and other characteristics of old-growth will be evident. However, the identification of an area as FOG does not imply that management will always promote old-growth characteristics in general or any community type in particular. FOG has no minimum stand age requirement because the area is moving toward old-growth on a long temporal scale.

Possible old-growth (POG) are stands likely to qualify as old-growth based on old-growth community type and stand age (Table 3 - 25). Through an examination of stand age (CISC database adjusted for year 2003, USDA Forest Service 1997a) all stands meeting old-growth age criteria were identified as possible old growth and documented in the Preliminary Inventory of Possible Old Growth, as described in Forest Report R8-FR-62. These POG stands are embedded in, and a part of, the various prescription areas across the forest. About 12,000 acres of POG have been identified and mapped (Table 3 - 27).

Table 3 - 26. Possible Old Growth on the DBNF.

Community	Pre-SPB (acres)	Post-SPB (acres)
Conifer-northern hardwood forest	1,400	1,400
Mixed mesophytic forest	728	728
River floodplain hardwood forest	61	61
Dry-mesic oak forest	532	532
Dry and xeric oak forest	1,483	1,483
Xeric yellow pine and yellow pine-oak forest	11,017	7,065
Dry and dry-mesic oak-yellow pine forest	912	912
TOTAL Acres	16,133	12,181

Change detection in Landsat Imagery was utilized to estimate the decrease in the dry-xeric pine and pine oak type resulting from the Southern Pine Beetle infestation.

The identification of a stand as *possible* old-growth does not imply any management decision regarding its status as old-growth. Management that could alter the stand's potential old-growth condition will be deferred until it has been inventoried and conditions determined. If the stand is identified as *existing* old-growth, that analysis will be followed by a project-level decision as to whether it will be managed as such. These decisions will be disclosed to the public. Stands managed as old-growth will be included in the 1.I. Designated Old-Growth Prescription Area. These stands will be addressed site-specifically during Forest Plan implementation, regardless of the alternative chosen. Over the life of the Plan, additional POG areas will be identified during project planning. These additional stands will be treated like the POG stands of the preliminary survey, with inventory of old-growth features taken and a determination of old-growth made and disclosed to the public prior to any management within the stand.

The area for this analysis includes all lands within the DBNF proclamation boundary.

Direct and Indirect Effects

COMMON TO ALL ALTERNATIVES

As the Forest ages, species that are found in old-age mesic stands in general, or old-growth mixed mesophytic forest in particular, will increasingly benefit as shade-tolerant species become more prevalent across the landscape. However, other species may decline since upland site species composition will change, tending to support less yellow pine, oak, and associated species. Exceptions will include areas where management emphasizes the thinning and burning required to maintain these communities described in USDA Forest Service (1997b), or edaphic conditions are such that xeric species dominate even without manipulation.

Across all alternatives, several Prescription Areas are regarded as *future* old-growth (FOG) because they may move toward old-growth conditions as a result of minimal treatment (Table 3 - 27). These areas include: Research Natural Areas (existing and proposed), Beaver Creek Wilderness, Clifty Wilderness, Wild and Scenic Rivers, Red River Gorge, and Natural Arch Scenic Area. Other prescription areas regarded as FOG include the Cliffline Community and Significant Bat Caves protection areas. Approximately 155,400 acres in these eight Prescription Areas are moving toward old-growth conditions. Although roads, improvements, and other signs of human manipulation exist, old-growth characteristics could eventually dominate the landscape of these areas. Promotion of old-growth characteristics, however, will not supersede the primary management objectives for which a Prescription Area was established. Land in these Prescription Areas will not be managed as old-growth, even though the majority of each probably will exhibit at least some old-growth characteristics, if nothing more than the existence of old trees.

All eight old-growth communities are found within these Prescription Areas. These include fire – adapted communities of two types, fire-mediated communities in which fire contributes heavily to composition and structure, and fire-influence communities in which fire contributes little to composition and structure. Fire-mediated habitat types (dry-mesic oak; dry and xeric oak; xeric pine and pine-oak; and dry and dry-mesic oak-pine forests) make up about 62 percent of the FOG areas described above. The prescribed fire and thinning required for restoration and perpetuation of these communities might conflict with other management objectives. As a result, the species composition in these systems would most likely move towards that found in mixed mesophytic communities. Thus, over time, yellow pine and oak communities may no longer be well represented across these FOG areas.

About 1,300 acres within mixed mesophytic forest have been identified as beech or beech/sugar-maple of varying ages. These stands may be available for sixbanded longhorn beetle habitat. Additional potential habitat likely exists within the mixed mesophytic type because stands containing a beech or sugar maple component are not always identified within CISC.

Based on regional direction (USDA Forest Service 1997b), POG stands will be field-inventoried for old-growth criteria. Eligible areas will be identified and could be managed as old-growth regardless of the surrounding prescription area. POG stands managed for old-growth conditions would be incorporated into the 1.I. Designated Old Growth prescription. Forest Service regulations set no minimum acreage or distribution criteria for old-growth, but once a stand is classified as old-growth, the direction in the plan is that it will be managed as such for the life of the Plan. Small or isolated stands might not qualify as functional old-growth, but may serve well to meet social/visual interests.

Table 3 - 27. Acres of *future* old-growth (FOG) by community, in Prescription Areas common to all alternatives.

Prescription area	Alternative[1]	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic Oak forest and woodland	Dry and xeric oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak forest, woodland and wooded grassland/shrubland[2]	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Uninventoried acres	Beech (totals included in mixed mesophytic forest)	Total acreage
1.A. Research Natural Areas	A	211	252	0	168	0	0	427	0	0	0	658
	B-1, C, C-1, D, and E-1	73	60	0	74	0	0	0	0	0	0	207
2.A & 2.B. Clifty & Beaver Creek Wilderness	A	4,424	1,695	0	2,837	1,896	1,670	480	0	47	10	13,059
	B-1, C, C-1, D, and E-1	1,229	581	0	1,723	1,550	1,138	349	0	16	3	6,586
1.C. Cliffline community	A	8,519	25,370	214	36,199	5,841	20,685	10,934	17	1,694	1,008	109,473
	B-1, C, C-1, D, and E-1	5,562	22,103	180	32,366	5,485	18,203	9,688	13	1,394	903	94,994
1.J. Significant bat caves	A	167	1,577	145	1,664	162	511	411	0	141	91	4,778
	B-1, C, C-1, D, and E-1	66	886	53	1,303	125	364	312	0	68	44	3,177
3.C. Wild & Scenic rivers	A	1,475	4,169	234	5,628	299	1,691	1,050	34	736	222	15,316
	B-1, C, C-1, D, and E-1	520	2,035	33	3,600	235	953	640	0	87	118	8,103
3.E. Red River Gorge[3]	A	2,218	2,883	20	3,127	2,068	807	521	0	90	0	11,734
	B-1, C, C-1, D, and E-1	1,037	1,533	1	1,990	1,841	631	501	0	9	0	7,543
3.F. Natural Arch Scenic Area	A	84	45	0	130	0	262	188	0	0	0	709
	B-1, C, C-1, D, and E-1	20	29	0	105	0	212	141	0	0	0	507
Totals	A	16,983	35,927	613	49,708	10,266	25,626	13,588	51	2,708	1,331	155,480
	B-1, C, C-1, D, and E-1	8,490	27,236	267	41,155	9,236	21,501	11,631	13	1,574	1,068	121,103

[1]Prescription Areas overlap in Alternatives B-1, C, C-1, D, and E-1 but not in A. The totals in columns reflect acreages that remain after the overlap has been removed. Overlapping acres have been included in the most restrictive Prescription Area.

[2]These acres have not been re-evaluated following the southern pine beetle epidemic, and may now have a severely diminished yellow pine component.

[3]In Alternative B-1, the Wilderness Study Area would be carved from 3.E. Red River Gorge Prescription Area. There would be no change in total FOG acreage.

ALTERNATIVE A

Under Alternative A, no stands or areas would be reserved specifically to conduct old-growth management or promote functionality in a Prescription Area (compare to Alternatives C, C-1, D and E-1, which include the 1.I. Designated Old-Growth Prescription Area). No areas would be managed specifically to maintain the old trees required for sixbanded longhorn beetle habitat. However, FOG areas would provide at least 1,300 acres of beech and sugar maple stands within mixed mesophytic forest that will, As these stands age, however, they will providing old-growth habitat.

Alternative A would call for the planting and restoration of almost 21,000 acres of yellow pine on National Forest System land in the first 10 years of the 2004 Plan. Another 30,000 acres would be planted over the next 70 years. Although this alternative has no Designated Old-Growth Prescription Area, it would provide for the most yellow pine restoration. Many of these stands would be managed for the possible re-introduction of red-cockaded woodpeckers, a species that requires mature, open yellow-pine communities. Even though these acres would not be managed for, or protected as, old-growth, most stands could reach at least 100 years of age, the defined minimum age for old-growth xeric pine and pine-oak forest and woodland (USDA Forest Service 1997b). National Forest System land would then provide, by far, the largest patchwork of mature pine stands within the proclamation boundary.

ALTERNATIVE B-1

As in Alternative A, there would be no Designated Old-Growth Prescription Area reserved specifically to conduct old-growth management and promote functionality. However, because the Desired Future Condition in Alternative B-1 would result in a landscape across which timber harvests and other human manipulation is minimized, nearly all of DBNF would move toward old-age mixed mesophytic forests. Therefore, old-growth characteristics would tend to prevail, and most of DBNF’s 700,000 acres would be moving toward *future* old-growth.

Along with Prescription Areas common to all alternatives that are FOG (Table 3 - 27), two other Prescription Areas, Riparian Corridor and Source Water Emphasis, would be found in this alternative as well as Alternatives C, C-1, D, and E-1 (Table 3 - 28). The Custodial Prescription Area, unique to this alternative, would increase FOG by approximately 395,000 acres. The Wilderness Study Prescription Area, also be unique to this alternative, would not contribute additional acreage to FOG. That land base would be removed from the Red River Gorge acreage, already considered FOG. Active management for viability reasons would occur on about 70,000 acres of the large Custodial Prescription Area. These stands would be classified as suitable for timber production and likely would not qualify as FOG.

All major forest types are currently represented across these Prescription Areas, but upland communities would be unlikely to reach and maintain old-growth status. Direction provided in this alternative would discourage the prescribed burning and thinning required to perpetuate these oak and yellow-pine communities. Thus, most of the acreage mentioned above would eventually succeed to mixed mesophytic hardwood species, white pine or eastern hemlock.

This alternative would not include a Designated Old-Growth Prescription Area that could promote the enhancement of upland communities, but it would call for some yellow pine restoration. About 4,300 acres of yellow pine seedlings would be planted every decade for the next eight decades.

About 2,200 acres would be restored to pine woodland or pine wooded grassland/shrubland while the rest would become forest with a much greater density of trees per acre. Therefore, even though these acres would not be managed or protected as old-growth, most stands could reach at least 100 years of age, the defined minimum age for old-growth xeric pine and pine-oak forest and woodland (USDA Forest Service 1997b).

Table 3 - 28. Acres of *future* old-growth (FOG) by community, in those Prescription Areas common only to Alternatives B-1, C, C-1, D, and E-1.

Prescription area[1]	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic Oak forest and woodland	Dry and xeric oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak forest, woodland and wooded grassland/shrubland[2]	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Uninventoried acres	Beech (totals included in mixed mesophytic forest)	Total acreage
1.E. Riparian corridor	7,085	34,925	2,296	49,631	4,281	13,944	10,557	142	5,063	1,583	127,924
5.C. Source water protection	317	1,533	1	1,990	1,841	1,144	501	0	9	0	7,336
Totals	7,402	36,458	2,297	51,621	6,122	15,088	11,058	142	5,072	1,583	135,260

[1]Prescription Areas overlap. The totals in columns reflect acreages that remain after the overlap has been removed. Overlapping acres have been included in the most restrictive Prescription Area.

[2]These acres have not been re-evaluated following the southern pine beetle epidemic, and may now have a severely diminished yellow pine component.

With the lack of a Designated Old-Growth Prescription Area, no areas would be managed specifically for sixbanded longhorn beetle habitat. Across the Forest, in prescription areas that are FOG, over 2,600 acres have been identified in the Continuous Inventory of Stand Condition as beech/sugar maple stands. However, minimal management within the Forest (not just in Prescription Areas that are FOG) under this alternative should lead to a substantial increase in habitat for the beetle. Beech and sugar maple trees should increase over time in mixed mesophytic stands as well as on dry sites as shade-tolerant species die out. Other species that require interior habitat should benefit unless they require large unbroken areas of upland interior habitat in particular.

ALTERNATIVES C, C-1, AND D

Under any of these three alternatives, identical land bases (Table 3 - 27 and Table 3 - 28) would provide *future* old-growth. The FOG acreage would total about 256,000 acres.

Alternatives C, C-1, and D also include a Designated Old-Growth Prescription Area, which would move over 270,000 acres toward old-growth conditions. Within the Designated Old-Growth Prescription, tracts would be managed specifically to promote the communities typically found prior to the era of fire exclusion. Prescribed fire would be a primary tool to promote upland old-growth communities. In other communities, where the historic fire regime has not been altered as extensively, prescribed fire would be less important.

The Designated Old-Growth Prescription Area was developed to provide at least eight percent representation of the eight old-growth communities types on the Forest, with corresponding old-growth conditions (USDA Forest Service 1997b) and associated species. About 15,300 acres within nine distinct units are found in this Prescription Area (Table 3 - 29). It should be remembered that acres classified by CISC as xeric pine or pine/oak most likely have been affected by the southern pine beetle epidemic. Therefore, they may in reality exist as dry and dry-mesic oak/pine, or dry-mesic oak.

Table 3 - 29. Acres of Designated Old-Growth by district, unit, and community, including acres of openings, in Alternatives C, C-1 and D.[1]

District	Old-Growth unit	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic oak forest and woodland	Dry and xeric oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak [2]	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Beech (totals included in mixed mesophytic forest)	Total forested acreage per old-growth unit	Acres of openings	Total acreage per unit
Morehead	**Yocum Cr.**	39	783	29	587	112	43	171	0	0	1,763	143	1,906
	Caney Cr.	0	86	21	1,506	72	189	595	0	0	2,468	85	2,552
Stanton	**Cave Hollow**	0	293	0	436	0	0	184	0	0	913	0	913
	Claw Tract	0	278	0	48	0	0	0	0	68	325	0	325
London	**White Oak Cr.**	353	95	0	1,398	93	202	21	0	0	2,162	0	2,162
	Horselick Cr.	6	1,020	51	567	87	223	15	43	56	2,012	5	2,017
Somerset	**Straight Creek**	0	381	0	543	0	223	88	0	47	1,235	0	1,235
Stearns	**Jellico**	0	966	0	783	413	41	0	0	46	2,203	100	2,303
Redbird	**Big Double Cr.**	47	1,239	108	446	0	0	0	23	589	1,863	55	1,918
	Total	445	5,141	209	6,314	776	920	1,074	66	806	14,944	388	**15,331**

[1]This prescription area is found in all alternatives, but only the Claw Tract would be incorporated in the prescription area in Alt. E-1.

[2]These acres have not been re-evaluated since the southern pine beetle epidemic; their yellow pine component may be severely diminished.

In the Designated Old-Growth Prescription Area, CISC identified about 800 acres of beech/beech-sugar maple within the approximately 4,300 acres of the mixed mesophytic forest type. Currently, 90 percent is older than 70 years. No forest type on the DBNF qualifies as old-growth at 70 years, but the distinction between age classes older and younger than 70 years highlights possible management changes over time.

Land purchases for establishment of the DBNF began about 70 years ago. The government purchased many tracts that had been logged by their former owners in the 1930s or earlier. Other tracts were purchased over the last 70 years, but the former owners first harvested timber from them. Most remaining stands were logged after being acquired by the Forest Service.

Some stands have been identified as *possible* old-growth, even if they are second growth. None have been field-inventoried to confirm that they are in fact old-growth. Over time, all stands can meet the three old-growth criteria (age class, basal area, and diameter at breast height of the largest trees), and most will show decreasing presence of the human disturbances that are inconsistent with old-growth attributes.

The Designated Old-Growth Prescription Area has been sorted by age classes in Table 3 - 30.

A) Minimum old-growth age (POG)

Because the minimum old-growth age criteria varies by forest type (e.g., conifer northern hardwood at 140 years and river Floodplain hardwood at 100 years) (Table 3 - 25), stands as young as 100 years for specific forest types were placed into this category. Only about two percent of the Designated Old-Growth Prescription Area meets the minimum old growth age criteria and was identified as *possible* old-growth. However, across the entire forest, regardless of Prescription Area, few stands are at least 100 years old.

B) Stands 0-70 years old

Some of these stands were logged after being acquired by the Forest Service. The remaining stands were logged by former owners and have been acquired by the DBNF within the previous 70 years. About one-fourth of the Prescription Area is in this age group.

C) Stands older than 70 years but not yet within minimum old-growth age

These are stands that have not been harvested since being incorporated into the DBNF but are not yet old enough to qualify as *possible* old-growth. Some of these stands may have been thinned but the overstory was not completely removed. Close to three-fourths of this Prescription Area is in this age group.

Table 3 - 30. The Designated Old-Growth Prescription Area sorted by stand age class, community, and acres.

Stand age class	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic oak forest and woodland	Dry and xeric Oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak forest, woodland and wooded grassland/shrubland	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Beech (totals included in mixed mesophytic forest	Total acreage per age class
A	0	0	13	0	43	43	92	0	0	191
B	169	1,607	53	1,077	68	490	257	56	66	3,777
C	246	3,534	143	5,237	665	387	725	10	740	10,937
Unknown	31							10		41
Total	446	5,141	209	6,314	776	920	1,074	66	806	14,946

[1] Stand Age Classes:

A) Minimum old growth age (POG) stands. The age at which a stand qualifies for old-growth varies by forest type and is based on criteria in USDA Forest Service 1997b. See Table 3 - 25 for a summary.

B) Stands 0-70 years old.

C) Stands more than 70 years old but not old enough to qualify as old-growth. See Table 3 - 25 for summary of qualifying age criteria.

A query run in the CISC database helped determine the type and total acreage of openings within the designated old-growth units (Table 3 - 31). Larger openings (particularly those caused by humans) with a large amount of edge, and those in which the resulting land use is quite different from the surrounding forest, may decrease the capability of the unit to function as ecologically sound old-growth (functional old-growth, versus an area of "old trees"). Overall, three percent of the Prescription Area is in openings such as utility, road and railroad rights-of-way, strip mines, water bodies (from ponds to impoundment backwaters), and grassy openings, and those maintained for special uses (Table 3 - 32).

Table 3 - 31. Amount and percentage of openings that occur in old-growth units within the Designated Old Growth Prescription Area.

District	Old-Growth unit	Unit size (acres)	Amount of forested land (acres)	Amount of openings (acres)	Percent of unit in openings
Morehead	Yocum Cr.	1,906	1,763	143	8
	Caney Cr.	2,552	2,468	85	3
Stanton	Cave hollow	913	913	0	0
	Claw Tract	325	325	0	0
London	White Oak Cr.	2,162	2,162	0	0
	Horselick Cr.	2,017	2,012	5	<1
Somerset	Straight Creek	1,235	1,235	0	0
Stearns	Jellico	2,303	2,203	100	5
Redbird	Big Double Cr.	1,918	1,822	55	3
	Total	15,331	14,903	388	3

Table 3 - 32. Description of non-forest openings that occur in old-growth units within the Designated Old Growth Prescription Area.

Old-Growth unit	Type of opening	Number of openings	Acres
Yocum Cr.	Grassy opening	3	73.6
	Water	1	69.7
	Total	4	143.3
Caney Cr.	Right-of-way	1	11.3
	Grassy opening	5	21.7
	Water	4	51.5
	Total	10	84.5
Horselick Cr.	Right-of-way	2	5.0
	Total	2	5.0
Jellico	Strip Mine	1	94.2
	Grassy opening	1	6.0
	Total	2	100.2
Big Double Cr.	Special use	2	18.9
	Strip mine	1	17.4
	Right-of-way	1	1.2
	Grassy opening	1	17.2
	Total	5	54.7
	Grand total	23	387

Alternatives C, C-1, and D include the 1.K. Habitat Diversity Emphasis Prescription Area in which the creation and perpetuation of mature open pine and oak communities would be encouraged. In the first decade, about 8,200 acres of yellow pine seedlings would be planted to begin restoration of that community type. Within the next seven decades, an additional 33,000 acres would be scheduled for planting. These stands would replace the pine and mixed pine-hardwood forests decimated by the southern pine beetle. In the long term, they would likely meet or exceed 100 years of age, the defined minimum for old-growth xeric pine and pine/oak forest and woodland (USDA Forest Service 1997).

The Desired Future Condition of the Habitat Diversity Emphasis Prescription Area calls for the creation and maintenance of between 120,000 and 160,000 acres of fire-mediated habitat. (The timeframe for the creation of this habitat depends on prescribed burning and other management levels.) Stands will reach the minimum age of old-growth prior to harvest and regeneration. In fact, this rotation is a long-term objective for the area, providing network connectivity for the old-growth community.

In the Habitat Diversity Emphasis Area old-growth characteristics would not necessarily be emphasized. Roads, trails, and human manipulation and presence could become common across the landscape. Therefore, the Designated Old-Growth Prescription Area remains important because it provides specific areas that would be managed for the purpose of establishing and maintaining old-growth conditions, as defined by tree and stand characteristics, including disturbance levels. Only the Designated Old-Growth Prescription Area will have that management strategy throughout the duration of the 2004 Forest Plan.

The old-growth conditions provided within any of these three alternatives would increase the potential for functional old-growth, at least 300 acres in size. Compared to Alternatives A, B-1, or E-1 they also would increase the chances of upland communities (dry-mesic oak; dry and xeric oak; xeric yellow pine and yellow pine/oak; and dry and dry-mesic oak/yellow pine forests) remaining in a fire-mediated seral stage. Prescribed burning and thinning would be permitted and encouraged to enhance these communities within the Designated Old-Growth Prescription Area. Without these management techniques, most of the yellow pine and oak communities would succeed to shade-tolerant hardwoods and possibly white pine and hemlock.

ALTERNATIVE E-1

As in the other alternatives, Prescription Areas involving little vegetative manipulation will move them by default toward Future Old-Growth (Table 3 - 27 and Table 3 - 28). These areas would be identical to those in Alternatives C, C-1, and D.

Under this alternative, the Designated Old-Growth Prescription Area would exist, but only the Claw Tract would be included (Table 3 - 29), at least initially. Other distinct units could be added to the Designated Old-Growth Prescription Area as a result of POG surveys or for other reasons.

The Claw Tract is included because it is within the Stanton Ranger District, the only district on which the sixbanded longhorn beetle has been found. Adequate beech/sugar maple habitat would be provided for the beetle between this unit (which has about 70 acres of beech/sugar maple), 1,500 acres of beech found within the Riparian-Aquatic protection area, and 1,100 acres in the other Prescription Areas that are FOG across the six districts.

The sixbanded longhorn beetle is the only species on the forest that appears to depend on old-growth for habitat. In this alternative, vegetation manipulation for biological diversity’s sake would be limited mostly to that required by the National Forest Management Act. No other forest type needs to be maintained in an old-growth condition to provide for the viability of any species.

However, about 4,300 acres of yellow pine seedlings would be planted every decade for the next 80 years to meet other viability requirements. A total of about 2,200 acres would be restored to pine woodland or pine wooded grassland/shrubland, and the rest will become forest (70+ basal area), which has a much greater density of trees per acre. The stands would be maintained with prescribed fire. These acres would not be managed for, or protected as old-growth, but most could reach at least 100 years of age, the defined minimum for old-growth xeric pine and pine/oak forest. (USDA Forest Service 1997b).

Old-growth conditions would be unlikely in any Prescription Areas or situations other than those described above. Additional thinning and prescribed burning to ensure maintenance of fire-mediated seral stages would likely be minimized. The largest Prescription Area in this alternative would be the Timber Production Emphasis area at nearly 395,000 acres. Old-growth management would conflict with strategies that emphasize timber production. Therefore, little, if any, of the forest in this or the remaining Prescription Areas would be likely to reach old-growth conditions.

CUMULATIVE EFFECTS COMMON TO ALL ALTERNATIVES

The incremental effects of other federal, non-federal, or private actions would not change, regardless of alternative. Any difference in cumulative effects would be reflected in the differences of an alternative's direct and indirect effects.

Within and adjacent to the DBNF proclamation boundary, the management of other public lands (Big South Fork NRRA; and Natural Bridge, Cumberland Falls, and Buckhorn Lake State Parks) is moving them toward an old-growth condition. These four parks add an additional 35,000 acres to the *future* old-growth base. The remaining land surrounding the Forest is primarily private or corporate-owned forested land, residential areas, or small farms. Any non-federal forest is subject to harvest at any time and old-age forests are not necessarily afforded any protection.

Regardless of the alternative chosen, the land outside National Forest System ownership would not influence the proposed designation of old-growth. However, an increase in old stands within the Forest would benefit local species that use interior forest, as well as old or large trees, by increasing the prospects for inter-connecting areas of functional old-growth. Thinning and burning to promote oak and oak/yellow pine (and the few remaining yellow pine) communities is or would be conducted on a small scale within areas surrounding the Forest. Nor do other land management agencies with holdings within the proclamation boundary plan to plant seedlings in former yellow pine stands. Restoration of yellow pine by means other than natural regeneration would occur mainly on National Forest System land.

RARE COMMUNITIES

Affected Environment

The extent of concern for rare communities in these discussions is limited to the area within the Daniel Boone National Forest proclamation boundary. Within this boundary are found lands of private (individual and corporate), state, and federal ownership. Forest Service management activities, except for land acquisition, would occur only on National Forest System land.

Rare communities are so called for a variety of reasons. Distributional rarity and conditional rarity are the traits that contribute most to recognition of rare communities on the DBNF. Distributionally, rare communities are usually tied to specific physical characteristics on the landscape. While such communities may be found scattered across large regions at varying densities, they are isolated on the landscape. A community may also be rare in a particular area, such as at the edge of its identified range, but otherwise frequent-to-common throughout its known distribution. Conditional rarity is related to the current vegetation structure of any habitat association. For example, a fire-mediated or fire-dependent community may be exceptionally rare in an area because long-term fire absence has drastically changed landscape conditions. With the introduction of fire in this case, the locally rare community could again become widespread and common. Distribution and condition can work together to influence rarity.

Few rare communities were recognized or documented until the DBNF participated in cooperative rare-species inventories (USDA Forest Service et. al. 1988-1994). During these inventories, many rare communities were discovered, and several have been located since. Some rare communities known to exist on the Forest are not yet organized in a spatial or tabular database, as much of the information acquired during the inventories was mapped at a gross scale showing large areas rather than specific rare communities. Table 3 - 33 shows the indicators used to evaluate this resource:

- Community names
- Number of known sites
- Estimated known acreage for each community type
- Estimated total acres around and including sites that would be managed.

The latter category is shown under “management acres” and includes the area around some rare communities in which management activities are conducted for the benefit of the community. The last column displays the nature of the rarity for the community on the DBNF.

An additional set of indictors is related to the management emphasis of a particular alternative. The combination of likely efforts to enhance rare communities, not just protect them, and the likely occurrence of unintended damage from dispersed recreation are considered. The lack of firm measures for either of these indicators requires the use of relative, rather than definite, levels of measurement.

RESOURCE TABLE

Table 3 - 33. Rare communities found on the DBNF, including the number of sites, estimate of community size and the number of surrounding acres managed to address or benefit the rare community.

COMMUNITY NAME	Number of Known Sites	Estimated Size (acres)	Management Area (acres)[1]	Rarity Type[2]
Streamhead Seeps/Bogs	60	5	1000	Distribution/Condition
Slope Seeps	10	5	Included above	Distribution
Swamps	2	4	80	Distribution
Natural Ponds	8	2	80	Distribution
Limestone Glades	4	2	8	Distribution/Condition
Sandstone Glades	6	15	30[4]	Distribution/Condition
Spray Cliffs	6	2	100[4]	Distribution
Canebrakes	10	8	16[5]	Distribution/Condition
Native Warm-season Grasslands	ca. 30	50	50[6]	Distribution/Condition
Wet Meadows	1	4	4	Distribution
Cedar Glades	ca. 5	80	80[7]	Distribution/Condition
Cedar-grass Woodland[3]	1-2	20-30	40	Distribution

[1]An estimate of the total acres around and including the sites for which management activities specifically address or benefit the rare community.

[2]Rarity Type: Distribution = sites that occur because of physical landscape features which themselves are rare; Condition = sites that are rare because of a dependence on a vegetative structure which may be created or maintained by active management within a habitat association

[3]These figures are estimates. This community is known to occur near the DBNF and undocumented sites may exist within the DBNF.

[4]Sites usually are found within the Cliffline Community Prescription Area.

[5]Sites usually are found within the Riparian Corridor Prescription Area.

[6]Sites usually are found within the Habitat Diversity Emphasis Prescription Area.

[7]Approximately 50 acres are found within the Cliffline Community Prescription Area.

Community Descriptions

Streamhead Seeps/Bogs are naturally occurring (rarely induced by human action) wetlands associated with low-order streams. As the name implies, they usually occur near the head of streams, usually 2nd and 3rd order. These are areas of boggy soils and vegetation formed in saturated pockets of sand. They are supplied water by both the stream and ground water seeps at geologic contact zones along the stream channel. Water flows perennially in these sites, although at times it is low-rate subsurface flow. Vegetation is dominated by herbaceous species with sphagnum moss species often dominant. Trees and shrubs may be present, usually at the margin or on hummocks. Fire may have a role in the maintenance and enhancement of these communities. These sites harbor many rare or uncommon species, such as white fringeless orchid and ginger-leaved grass of Parnassis. The numerous crayfish that inhabit these sites may include undescribed species. The sites are sensitive to changes in water flow, especially changes in surface water flow.

Slope Seeps are naturally occurring wetlands associated with extensive geologic contact zones. Low-order streams are generally located down slope, but drain, rather than feed, these wetlands. Like streamhead seeps and bogs, these areas are boggy, formed on saturated soils. Water flows perennially in these sites, although at times, it is low-rate subsurface flow. Vegetation is dominated by herbaceous species with sphagnum moss species often dominant. Trees and shrubs may be present. Fire may have a role in the maintenance and enhancement of these communities. These sites harbor many rare or uncommon species, such as the caric sedge *Carex seorsa*, and the liverwort *Telaranea nematodes*.

Swamps are naturally occurring wooded wetlands. They are characterized by standing water throughout the year (some drying may occur in drought years) with the presence of trees tolerant of flooding. They form in depressions where clay layers prevent seepage of water out of the area. Swamps are found in upland and floodplain positions. Water may come from flooding, stream inflow, or ground water sources. Trees dominate the vegetation, but tufts of emergent herbaceous species are common. These harbor many rare or uncommon species such as the uptight caric sedge.

Natural Ponds are naturally occurring water bodies. On the DBNF, they occur along ridgetops, usually on those capped by sandstone. They can appear as old farm ponds, usually with trees growing in or at their edges. Frequently, the buttonbush shrub is found in these ponds. Ponds may harbor rare or uncommon species such as pond caric sedge. Several of these ponds have yielded pollen and charcoal records from bottom sediments. However, dredging or fill over the last 200 years has altered many of these ponds. Many retain water throughout the year, except in drought years, but some regularly dry out.

Limestone Glades are naturally occurring areas (rarely induced by human action) of thin soil on limestone cliffs or outcrops. Tree growth is absent or severely stunted, although shrubs may be present. Vegetation dominated by herbs, usually grasses and sedges, is often sparse. Most glades are dry, but they can have seeps associated with them. Infrequent, low intensity fire may play a role in maintenance and enhancement. They harbor rare or uncommon species such as mountain lover and nettleleaf noseburn.

Sandstone Glades are naturally occurring areas of thin soil on sandstone cliffs or outcrops. Tree growth is absent or severely stunted, although low shrubs are commonly present. Vegetation is dominated by low shrubs or herbs, and may be sparse. Most glades are dry, but they can have seeps associated with them. Infrequent, low intensity fire may play a role in maintenance and enhancement. They harbor rare or uncommon species such as fameflower and box huckleberry.

Spray Cliffs are naturally occurring areas (rarely induced by human action) found at and adjacent to waterfalls. They are zones of high humidity, constant moisture, and cool temperatures created by waterfall spray. Portions of the cliff are often shaded, further enhancing moist, cool conditions. Spray cliff zones harbor many rare or uncommon species such as little mountain meadow rue and sword moss.

Canebrakes are naturally occurring grasslands or wooded grasslands dominated by a variety of cane, a native bamboo. They are usually dense and once extended for tens of acres. Canebrakes are usually associated with river flood plains (river cane form), but also occur on uplands (hill cane form). Many of the canebrakes on the forest are in poor condition, and all are small. Cane itself is somewhat uncommon on the DBNF. Periodic fire helped maintain these communities. Canebrakes may once have been primary habitat (Brantley and Platt 2001; Trani-Griep 2002) for the uncommon Swainson’s warbler.

Native Warm-season Grasslands usually occur naturally (as opposed to areas created by human action). These grasslands, dominated by warm-season grasses, may occur on roadsides, in utility corridors, or as forest openings. Many of these areas are edaphically controlled, but most are maintained by periodic fire. Historically, they were associated with burned yellow pine, upland oak and mixed oak-yellow pine woodlands, occurring as open areas between clusters of trees, i.e., in wooded grasslands, woodlands, or as the understory in open forest. Today, they exist as isolated pockets of vegetation, often no longer in the context of fire maintained or enhanced woody plant communities. In the grassland areas, trees are usually absent, although small shrubs and saplings may be found in sites of poorer condition. These areas are generally small, often less than one-quarter acre, but occurrences can be up to 20 or 30 acres in size. Native warm-season grasslands provide habitat for many rare or uncommon species such as royal catchfly and yucca-leaved rattlesnake master. In conjunction with woodland, they provide habitat for uncommon species such as eastern slender glass lizard and Diana fritillary.

Wet Meadows are native communities associated with fragipan soils or ground/surface water sources that maintain moist to wet soils through most of the year. Cool-season grasses (some warm-season may be present), sedges and rushes dominate the vegetation. Various forbs are present. Woody plants are generally few, primarily small shrubs. Wet meadows often associated with river flood plains, may occur on broad toe slopes and ridges. They provide habitat for rare or uncommon species such as grass-pink and if large enough sedge wren.

Cedar Glades are naturally occurring communities associated with usually dry limestone outcrops and cliffs. On the DBNF, most are along ridgetops, but at least one is on a limestone slope. The sites are rocky with thin soil. Eastern redcedar is often the dominant woody species, but past management may have diminished redcedar, allowing oaks and ashes to dominate. The canopy may be open with either a grass-forb or shrub dominated understory. Closed canopies often have sparse understories with extensive thickets of catbrier and sawbrier. Infrequent, low-intensity fire may be important in the maintenance of these communities. The open canopy condition provides habitat for many rare or uncommon species such as mountain lover and Harris's goldenrod.

Cedar Woodlands/Grasslands here are defined as a naturally occurring mosaic of eastern redcedar and predominately native grass-sedge patches. The communities often appear as overgrown abandoned fields but are dominated by native species. These communities occur on siltstone (rarely other calcareous substrates including mudstone and limestone) slopes. Generally dry, a combination of infrequent fire and edaphic conditions help maintain these community sites. Herbivory by large ungulates (grazing by large, hoofed mammals) may have occurred in the past. This community type is known in Bath County, but has yet to be documented on the DBNF. This community type is known to provide habitat for the rare Juniper sedge. This community is listed here since there is some possibility it occurs on the forest, and there is a need to recognize the community. The number of sites and acres are estimates of potential occurrence. Additionally, juniper sedge occurs more frequently in an oak dominated variant of this community type at the southern edge of its range (Naczi and Ford 2001). This community variant is included here if it occurs with juniper sedge.

Environmental Effects

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Known rare communities affected by implementing Alternative A are shown in Table 3 - 33. From a programmatic view, this alternative would allow for the direct protection and enhancement of rare communities, but would not specifically direct such action. Alternative A does not specifically identify rare communities by type for specific management, but neither does it prevent such identification. The effect of implementing this alternative could include inadvertent damage to communities not recognized or identified in site-specific analysis and missed opportunities to improve conditions within those communities. Given the emphasis of Alternative A, the number of actual existing sites may not be discovered. This in turn affects the actual number of acres managed for rare community values. Relative acres of communities that are rare due to distribution or condition are likely to remain as currently known. The current condition reflects action under the 1985 Plan (represented by Alternative A) for the last 10 years. The relative levels of management for rare communities and inadvertent damage from dispersed recreation are expected to remain near current levels, which also reflects management action for the last 10 years. Also, in site-specific projects, the relationship of specific community locations and conditions to other, similar sites on the forest could be overlooked.

CUMULATIVE EFFECTS

Some protection and management of rare communities would occur under this alternative during site-specific project analysis and implementation. Rare communities would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on property that included many of these communities. Growth along the I-75 corridor is expected to continue with development likely on many more private lands that contain rare community elements. As these communities are altered or replaced by other land uses, the overall distribution of rare communities would be decreased. New land uses could also render locations less favorable to rare community elements, increasing their rarity. Management of such communities on National Forest System land would at least help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is intended primarily to protect, rather than actively maintain, rare communities. With time, protection alone may result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, where habitats are maintained for the specific values desired in each rare community, the likelihood of the communities remaining on the landscape for the long-term would increase. The communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and specifically identify rare communities by type for specific management. From a programmatic view, Alternative B-1 should support the continued existence and health of these communities, although only at a minimal level. Management activities prescribed in this alternative should help maintain conditions within all rare communities, but may only enhance some of them. However, given the emphasis of the alternative, all existing sites may not be discovered. Identification will determine the acreage to be managed for rare community values. Relative acres of communities, rare due to distribution or condition, would likely to remain stable, although a small decrease in rarity due to condition could occur as some rare community enhancement is expected. The relative level of management for rare communities is expected to increase slightly over the current condition, primarily in the form of recognition of specific community types and appropriate management action to maintain sites. Inadvertent damage from dispersed recreation is expected to decrease from the current condition as dispersed recreation decreases. National Forest System land included in the Rare Communities Prescription Area and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under Alternative B-1. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency action often proceeds without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on property that included many of these communities. Growth along the I-75 corridor is expected to continue, with the likely development of many more areas of private lands that contain rare community elements. As these communities are altered or replaced by other land uses, the overall distribution of the communities is decreased or conditions within them become less favorable for maintaining the community, and they become more rare. Management of these communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally designed only to protect rare communities, not maintain or enhance them. With time, protection alone may result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats would be maintained for the specific values desired in each rare community. Doing so would increase the likelihood of sustaining these communities on the landscape for the long-term. Rare communities generally occupy rather different locations or conditions on the landscape and do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and specifically identify rare communities by type for management. From a programmatic view, Alternative C should support the continued existence and health of these communities, not only maintaining, but also enhancing conditions within all or most rare communities. Given the emphasis of this alternative, the actual number of existing sites is more likely to be discovered than in other alternatives. Identification would determine the actual number of acres to be managed for rare community values. Relative acres of communities, rare due to distribution, may decrease or remain stable depending on the community. If conditions within rare communities improve, a decrease in the number of those rare due to condition would be expected. The relative level of management for rare communities could be expected to increase above current conditions as specific community types are recognized and appropriate management action is taken to enhance these communities. Inadvertent damage from dispersed recreation can be expected to remain stable. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under Alternative C. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency action often proceeds without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on property that included many of these communities. Growth along the I-75 corridor is expected to continue, with the likely development of many more areas of private lands that contain rare community elements. New land uses could also render locations less favorable to rare community elements, increasing their rarity. Management of these communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally to protect, rather than actively maintain, rare communities. With time, protection alone may result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats are maintained for the specific values desired in each rare community. Doing so would increase the likelihood of sustaining these communities on the landscape for the long-term. The communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and expressly identify rare communities by type for specific management. From a programmatic view, Alternative C-1 should support the continued existence and health of these communities. Favorable conditions within all or most rare communities would be enhanced, not just maintained. Given the emphasis of this alternative, the actual number of existing sites is more likely to be discovered. Identification determines the number of acres to be managed for rare community values. Relative acres of communities, rare due to distribution, may decrease or remain stable depending on the community. As conditions within rare communities improve, the number of those rare due to condition can be expected to decrease. The relative level of management for rare communities can be expected to increase beyond the current condition primarily through recognition of specific community types and appropriate management action to enhance these communities. Inadvertent damage, such as trampling and alteration of hydrology, from dispersed recreation would be expected to increase as dispersed recreation levels rise. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under Alternative C-1. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered the quality or uses of property that included many of these communities. Growth along the I-75 corridor is expected to continue with the likely development of private lands that contain rare community elements. New land uses could also render locations less favorable to rare community elements, increasing their rarity. Management of these communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park lands within the proclamation boundary. Management on these lands, however, is generally designed to protect, rather than actively maintain, rare communities. With time, protection alone could result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats would be maintained for the specific values desired in each rare community, and they would be more likely to endure over the long-term. Rare communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and expressly identify rare communities by type for specific management. From a programmatic view, Alternative D should enhance conditions favorable to rare communities, not just maintain them. Given the emphasis of this alternative, existing rare community sites are more likely to be discovered. Actual acreage helps determine management for rare community values. Relative acres of communities, rare due to distribution, could decrease or remain stable depending on the community. As conditions within rare communities improve, the number of those rare due to condition is likely to decrease. The relative level of management for rare communities would be expected to increase primarily through recognition of specific community types and appropriate management action to enhance them. Inadvertent damage, such as trampling and alteration of hydrology, from dispersed recreation could be expected to increase as dispersed recreation levels rise. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would expressly afford protection and management under this alternative. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered the qualities or uses of lands that included many of these communities. Growth along the I-75 corridor is expected to continue with the likely development of private lands containing rare community elements. As these communities are altered or replaced by other land uses, the overall distribution of rare communities is decreased, or conditions within them become less favorable and they become more rare. Management of rare communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally to protect, rather than actively maintain, rare communities. With time, protection alone could result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats would be maintained for the specific values desired in each rare community. Doing so should increase the likelihood of sustaining them on the landscape for the long-term. Rare communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription and expressly identify rare communities by type for specific management. From a programmatic view, Alternative E-1 should support the continued existence and health of these communities, although only at a minimal level. Management activities prescribed in this alternative should help maintain conditions within all rare communities, but may enhance only some of them. Given the emphasis of Alternative E-1, the exact number of existing sites may not be discovered. Identification determines the number of acres managed for rare community values. Relative acres of communities, rare due to distribution or condition, are likely to remain stable, although a small decrease in rarity due to condition may occur as some rare community enhancement is expected. The relative level of management for rare communities can be expected to increase beyond current conditions primarily through recognition of specific community types and appropriate management action. Inadvertent damage from dispersed recreation would likely increase because dispersed recreation can be expected to expand. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under this alternative. They would have greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on land that included many of these communities. Growth along the I-75 corridor is expected to continue along with development of private lands containing rare community elements. As these communities are altered or replaced by other land uses, their overall distribution is decreased or conditions within them become less favorable, increasing their rarity. Management of these communities on National Forest System land would help ensure their existence within the proclamation boundary. Some rare communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally to protect rather than actively maintain rare communities. With time, protection alone may result in loss of some sites on state land.

OTHER EFFECTS

In the short-term, these habitats are maintained for the specific values desired in each rare community. Doing so increases the likelihood of sustaining rare communities on the landscape for the long-term. Rare communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

VEGETATION COVER

Affected Environment

Most of the DBNF lies in the generally forested Northern Cumberland Plateau. A small area lies in the generally less forested eastern portions of the Mississippian Plateau along the western edge of the Northern Cumberland Plateau. Portions of the Northern Cumberland Plateau, especially at the transition into the Bluegrass and Mississippian Plateau and along large river bottoms, are frequently cleared for pasture or row crops. Areas within the coalfields of the plateau often have large deforested areas associated with mining. For analysis, this discussion is limited to the area within the DBNF's proclamation boundary. Land within the proclamation boundary is generally forested, but the western edge at the transition into the Bluegrass region and the Mississippian Plateau, and along large river bottom land in private ownership, is frequently cleared for pasture or row crops. Portions of land within the proclamation boundary are in extensive grassland following mining activities.

National Forest System land totals approximately 697,900 acres or about one-third of the approximately 2.1 million acres within the proclamation boundary. Three state parks (Natural Bridge State Resort Park, Cumberland Falls State Resort Park, and Buckhorn Lake State Resort Park) covering about 4,400 acres, the Big South Fork National River and Recreational Area covering about 31,350 acres, and the state managed Beech Creek Wildlife Management Area (WMA) occupying about 1,250 acres lie within the proclamation boundary. Individuals or corporations own the remaining land within the proclamation boundary, approximately 1,368,000 acres.

On the Daniel Boone, the Continuous Inventory of Stand Condition (CISC) database (USDA Forest Service 1997) provides an approximate record of forest type and age. The database also provides an approximate record of land not in forested condition. Figure 3 - 21 displays this information as recorded through 1997. National Forest System ownership includes approximately 17,230 acres of water surface or land that is subject to yearly seasonal flooding, mostly associated with the three large reservoirs within or bordering the forest. Another 3,930 acres are open lands associated with utility corridors, old surface mines, and road or railway rights-of-way. About 2,144 acres are classified as grassy openings. A more recent survey (USDA Forest Service 2002) indicates that this number is approximately 2,171 acres. The various forest association acres are found in Figure 3 - 21.

Beginning in late 1999, a severe southern pine beetle infestation drastically reduced the number of southern yellow pine (SYP) and SYP-hardwood forest acres found on the DBNF. The exact extent of change is not currently known, but current estimates suggest that only about 1,200 acres of SYP-dominated forest remain, most of which is between one and 10 years old. The area of hardwood-SYP forest has probably decreased about 17,500 acres. Individual yellow pine trees remain scattered across the forest, but usually not in enough concentration to qualify an area as either SYP-dominated or hardwood-SYP forest.

Other stochastic events, primarily storm events, which affect the composition and structure of vegetation on the landscape are expected to occur. Based on events over the last 15 years, it is estimated that about 7,000 acres (slightly more than 1 percent of the forested land area with the Daniel Boone National Forest) a decade, on average, will be put into condition similar to the 0-10 year old early-aged forest condition. This is described as less than or equal to 40 sq ft basal area of overstory trees and at least 200 well-distributed seedlings of tree species 10 or fewer years old. Management activities will take these areas into account when prescribing actions to meet desired future conditions. Additional areas of forest not meeting the early-aged forest definition, but affected by stochastic events are also expected, with an estimate of up to 10,000 acres a decade on average. These areas may resemble heavy thinnings or consist of heavily damaged trees, and even have elements of early-aged forest, but do not fit the category of early-aged forest. Management actions will also take these into account.

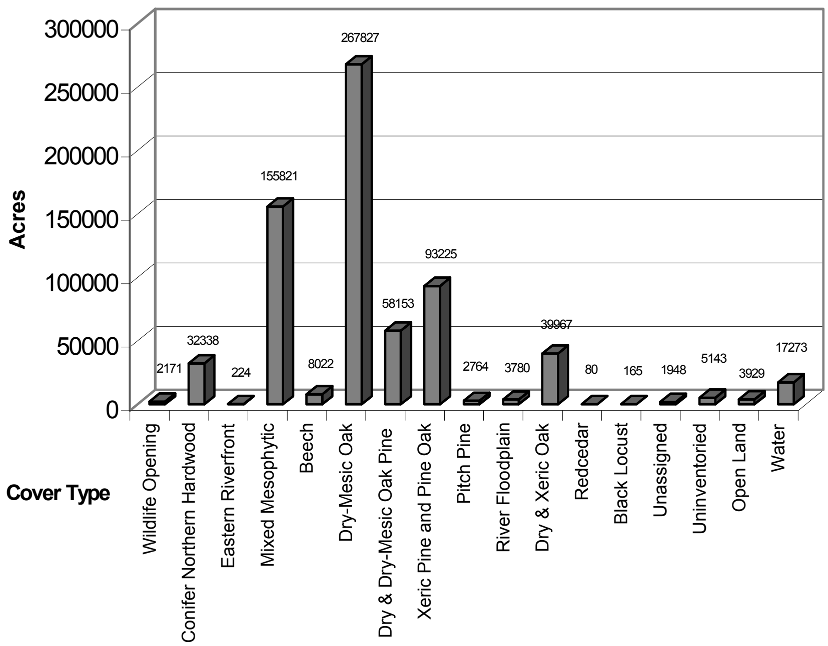

Figure 3 - 21. Acres of Habitat Association and non-forest land through 1997.

Forest age structure, based on 1997 data with age adjusted to year 2002, is presented in Figure 3 - 22. Current age class distribution is bi-modal with concentration of acres in ages between 11-40 years old and 61-110 years old. The current trend is towards generally older forest. There is a long, low tail in the older age classes, but about 2,163 acres are older than 150 years, and about 638 acres are older than 200 years. The oldest forest stands are between 230 and 240 years old (all hemlock-hardwood). Grassland acres are based on 2002 data. The restructuring of age classes following the death of yellow pine trees is estimated in this chart. About 36,200 acres of SYP-dominated forest is estimated to have been set back to the 1-10 year age class in an oak-SYP or oak-hardwood forest type. Most of these acres came from the 71-120 year old age group, but some came from the 11-70 year old age group. Table 3 - 34 below shows estimated acres for a variety of habitats over time for all alternatives.

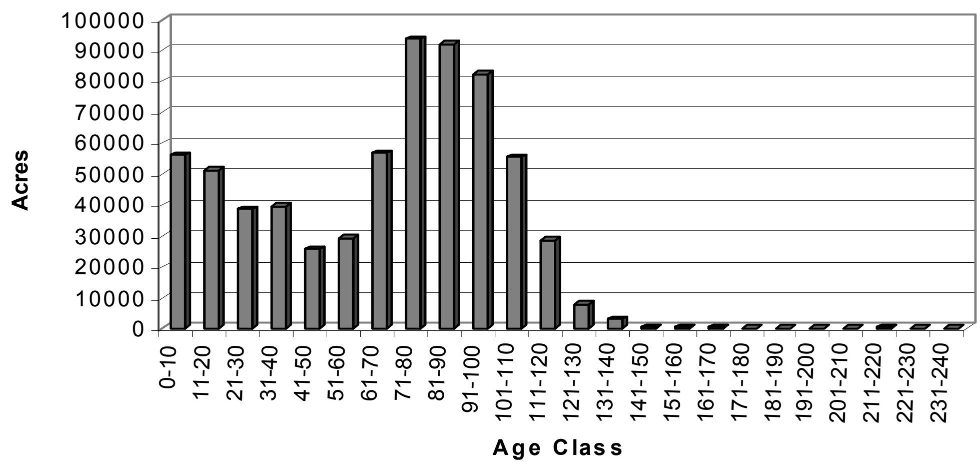

Figure 3 - 22. Acres By Age Class through 2002, adjusted for death of pine stands.

RESOURCE TABLE

Table 3 - 34. Acres[1] of Selected Terrestrial Habitat Types, Current, and by alternative. (Totals by decade).

CONDITION	2002	Decade[2]	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt E-1
Grassland	2171	1st	2271	900	2200	2200	2200	900
		2nd	2371	900	2200	2200	2200	900
		5th	2800	900	2200	2200	2200	900
Wooded grassland/shrubland (Pine)	0[3]	1st	0	110	110	110	110	110
		2nd	0	110	110	110	110	110
		5th	0	110	110	110	110	110
Wooded grassland/shrubland (Hardwood)	0[3]	1st	0	610	660	660	660	610
		2nd	0	640	1330	1330	1330	640
		5th	0	640	11424	11424	11424	640
Woodland (Pine)	0[3]	1st	0	362	100	100	100	362
		2nd	0	500	100	100	100	867
		5th	0	500	500	500	500	1396
Woodland (Hardwood)	0[3]	1st	0	2871	5570	5570	5570	2871
		2nd	0	2871	25273	25273	25273	2871
		5th	0	2871	39632	39632	39632	2871
Forest, 60-70 BA overstory	500[4]	1st	15000	1825	9000	9000	9000	23986
		2nd	15000	1925	8000	8000	8000	21137
		5th	15000	1825	8000	8000	8000	21635
Riparian (prescription) land only	N/A	1st	N/A	138800	138800	138800	138800	138800
		2nd	N/A	138800	138800	138800	138800	138800
		5th	N/A	138800	138800	138800	138800	138800
Riparian (100 year floodplain)[6]	100,000	1st	100,000	100,000	100,000	100,000	100,000	100,000
		2nd	100,000	100,000	100,000	100,000	100,000	100,000
		5th	100,000	100,000	100,000	100,000	100,000	100,000
0-10 year old Yellow Pine (restoration)	1200	1st	20830	4363	8216	8216	8216	4363
		2nd	35259	8726	16232	16232	16232	8726
		5th	46799	21797	40320	40320	40320	21810
Cliff zone (mixed forest types)	110843	1st	110843	110843	110843	110843	110843	110843
		2nd	110843	110843	110843	110843	110843	110843
		5th	110843	110843	110843	110843	110843	110843
Pitch pine	0[5]	1st	0	1000	1000	1000	1000	1000
		2nd	0	2000	2000	2000	2000	2000
		5th	0	3000	3000	3000	3000	3000
Beech	8022	1st	8022	8022	8022	8022	8022	8022
		2nd	8022	8022	8022	8022	8022	8022
		5th	8022	8022	8022	8022	8022	8022

CONDITION	2002	Decade[2]	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt E-1
Hemlock/white pine	21389	1st	21389	21389	21389	21389	21389	21389
		2nd	21389	21389	21389	21389	21389	21389
		5th	21389	21389	21389	21389	21389	21389
Conifer Northern Hardwood	11986	1st	11986	11986	11986	11986	11986	11986
		2nd	11986	11986	11986	11986	11986	11986
		5th	11986	11986	11986	11986	11986	11986
Mixed Mesophytic	147980	1st	147980	147980	147980	147980	147980	147980
		2nd	147980	147980	147980	147980	147980	147980
		5th	147980	147980	147980	147980	147980	147980
Dry Mesic Oak	268291	1st	322001	322001	322001	322001	322001	322001
		2nd	316549	322001	322001	322001	322001	322001
		5th	316549	316549	316549	316549	316549	316549
Dry Xeric Oak	40030	1st	40030	40030	40030	40030	40030	40030
		2nd	40030	40030	40030	40030	40030	40030
		5th	40030	40030	40030	40030	40030	40030
Dry Mesic Pine Oak	65292	1st	51148	59341	59341	59341	59341	59341
		2nd	40707	56532	56532	56532	56532	56532
		5th	40707	56532	56532	56532	56532	56532
Dry Xeric Pine Oak	30813	1st	24872	28004	28004	28004	28004	28004
		2nd	18931	25195	25195	25195	25195	25195
		5th	18931	25195	25195	25195	25195	25195
0-10 year old forest	56171	1st	50000	7000	22279	22279	22279	36364
		2nd	50000	7000	22279	22279	22279	36364
		5th	38240	7162	21519	21519	21519	36364
11-50 year old forest	155361	1st	185941	185941	185941	185941	185941	185941
		2nd	196360	153360	168640	168640	168640	182724
		5th	180413	77326	89116	89116	89116	145456
61-130 year old forest	416669	1st	388037	430317	414988	414988	414988	400953
		2nd	334976	420133	388978	388978	388978	361498
		5th	237007	320470	283764	283764	283764	262729
151-200 year old forest	1436	1st	1958	1958	1958	1958	1958	1958
		2nd	4853	4853	4853	4853	4853	4853
		5th	69297	90267	78474	78474	78474	68982
200+ year old forest	722	1st	789	789	789	789	789	789
		2nd	964	964	964	964	964	964
		5th	1520	1520	1520	1526	1526	1526
Mast-producing forest (51-200 year old oak)	212422	1st	200894	220807	213587	213587	213587	206977
		2nd	195903	236012	221338	221338	221338	208395
		5th	208392	294160	253836	253836	253836	225387

[1]1997 data adjusted for age as of 2002.

[2]Acres presented are per decade totals, except woodland and wooded grassland/shrubland acres, which are cumulative totals.

[3]These are presumed 0 acres. There may be some areas with similar structural characteristics on the ground at present as a result of the southern pine beetle infestation, but they are unlikely to have had fire applied to develop herbaceous and low shrub layers.

[4]This figure is an estimate. This condition was not commonly achieved during the last 10-15 years, and was not generally tracked when accomplished.

[5]The model used to account for yellow pine loss on the forest assumed almost total loss. This is unlikely to be the case. It is not known at present how much yellow pine, including pitch pine, remains on the DBNF.

[6]Acres estimated using a DEM model through GIS.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Direct and indirect effects on forest community and age structure from implementation of the 2004 Forest Plan direction vary by alternative. Based on projected conditions over the next five decades, the expected changes in community and age structure for each alternative are presented below. In each case it is assumed that most stand regeneration would occur in stands at least 61 years old, where the age class is represented by at least 32,000 acres across the Forest. This tends to focus management activity in the older concentration of acres in each of the five decades.

The effect of each alternative on forest age and community structure in turn affects management indicator species (MIS), especially terrestrial species. Vegetative condition (age, structure, composition) determines the available habitat for terrestrial MIS and other species. Descriptions of effects on terrestrial MIS are included for each alternative. In all cases, alternatives are assumed implemented as planned and are compared to existing conditions as reflected in the Continuous Inventory of Stand Condition as well as estimates of habitat changes following the southern pine beetle epidemic.

The effects on two MIS would be similar for all alternatives. The pine warbler, which is dependent on older southern yellow pine (70-80+ years), would not be provided for in the first five decades. However, all alternatives would provide for the species in the long-term, 7 to 8 decades from implementation. Regardless of alternative, the pine warbler species may persist in low numbers in remaining pockets of older yellow pine. Northern bobwhite quail, currently in low numbers associated with grasslands and open, burned yellow pine or yellow pine-oak forest on the DBNF is expected to be found more abundantly in open, grassy southern yellow pine or mixed yellow pine-oak woodland and wooded grassland. This species would not be provided for in the first four decades. But in the long-term, 5 to 7 decades from implementation, all alternatives would provide some habitat for the species. In any case, northern bobwhite quail may persist in low numbers in grassy utility rights-of-way or road corridors.

CUMULATIVE EFFECTS

The incremental effects of other federal, non-federal, or private actions would not change, regardless of alternative. Any difference in cumulative effects would be reflected in the variation of an alternative's direct and indirect effects.

The state and national parks within the proclamation boundary will trend toward older forest, including areas greater than 150 years of age, with limited young age forest areas, and limited habitat for young age forest MIS (yellow-breasted chat and eastern towhee). The grassland MIS, field sparrow, is unlikely to be provided for in these areas, but may persist in utility rights-of-way or along road corridors. MIS associated with Southern yellow pine (prairie warbler and pine warbler) would not likely be provided for in these areas. Northern bobwhite quail may persist in utility rights-of-way or along road corridors, but active habitat management for the species is unlikely. Pitch pine would exist only where it survived the southern pine beetle epidemic. Woodland and wooded grassland/shrubland MIS (northern cardinal, summer tanager, and chipping sparrow) would not be provide for in these areas. State and national parks would provide habitat for riparian MIS (Acadian flycatcher) and older forest MIS (cerulean warbler, black-throated green warbler, ovenbird), however. The relative mix of forest communities would remain the same over five decades. The state of Kentucky's Beech Creek Wildlife Management Area will provide a variety of forest age classes but is unlikely to have forest over 150 years old. MIS should be provided for in this area except for yellow pine and woodland and wooded grassland/shrubland species. Riparian MIS may or may not be provided for on site-specific projects. The relative mix of forest communities would remain the same over the next five decades.

Private actions on non-forest lands frequently include the maintenance of grassy openings in the form of fields, pastures, and lawns. Whether it is suitable habitat for a given species depends on factors such as the size of the area, its condition and composition, its location relative to houses and other buildings, and the habitat context in which it occurs (see Fragmentation section). This is best determined during site-specific project analysis. Private land may provide a range of forest communities, including a range of age classes from recently cut forest to stands greater than 150 years of age. However, events on private land are somewhat unpredictable and the relative amount of young versus old stands and relative balance of forest communities is always in question from year to year. Likewise, available habitat for MIS is unpredictable. However, analysis of satellite data suggests a slight increasing trend in forested land around the DBNF, with a corresponding slight decrease in open or grassy land. Recent Forest Inventory and Analysis data suggest that about 6.5 percent of all land (about 133,000 acres) in all ownerships within the proclamation boundary is in seedling/sapling (early aged forest) condition. Part of this is pasture and cropland reverting to forest, and part is land on which timber harvest has occurred.

OTHER EFFECTS

Other effects remain the same among alternatives. That one particular piece of land exists in one habitat form used by one organism and not in another habitat form used by a different organism implies that not every piece of ground at any one time is beneficial to any organism or group of organisms. This is seen in practice: an ovenbird generally is not found in a 0-10 year old shelterwood harvest area, and a yellow-breasted chat generally is not found in 70-80 year old forest. Areas may be maintained in a particular habitat condition for either short or long periods, during which they are not available as habitat for a species requiring different conditions.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Alternative A in the 1985 Plan would schedule about 6,000 acres of forest regeneration per year (about 60,000 acres per decade). This was adjusted with revised volume tables to about 5,000 acres per year (about 50,000 acres per decade). Of this, approximately 3,000 acres per year would be harvested in hardwood or northern conifer forest types. The remaining amount, about 2,000 acres per year, reflects regeneration of yellow pine forest types. The yellow pine regeneration would be expected in areas affected by the southern pine beetle epidemic and may not result in timber harvest. As compared to current conditions, this would increase the acreage of young-age forest stages but decrease acres of older forest, particularly in the 61-130 year old range (Figure 3 - 23, Figure 3 - 24, and Figure 3 - 25. The number of acres of forest producing hard mast would likely decrease.

The application of prescribed fire in this alternative should help maintain herbaceous and woody diversity on the forest and promote the retention of oak dominated uplands and re-establishment of yellow pine dominated uplands. With the exception of southern yellow pine dominated forest, no appreciable change in relative amounts of forest communities would be expected. About 35,000 acres of southern yellow pine would be replanted over the next two decades in areas decimated by the southern pine beetle. About 46,800 acres of southern yellow pine would be replanted over the next five decades in areas decimated by the southern pine beetle. About 2,371 acres of grassy openings would be maintained by the end of the second decade for species requiring grassland habitat. About 2,800 acres of grassy openings would be maintained by the end of the fifth decade for species requiring grassland habitat. This alternative would not contain a specific riparian prescription area, (no change from current condition) and the condition of riparian habitat in the alternative would be determined by site-specific analysis.

This alternative would provide for early-age forest for three management indicator species, white-tailed deer, eastern bluebird, and rufous-sided towhee (now called eastern towhee). White-tailed deer, in this alternative, is tied specifically to regeneration conditions (0-10 year-old forest). In the first decade, around 50,000 acres of 0-10 year-old forest would be provided for this species. While this would be about an 11 percent decrease from current levels, this condition should remain stable through at least the 5th decade. Based on recent analysis (USDA Forest Service 2000), this change in habitat conditions may not necessarily change population numbers. Eastern bluebird in this alternative is specifically tied to snag/cavity development in the context of grassy openings or 0-10 year forest. In the first decade, about 2,300 acres of grassy openings would be provided, an increase of about 4 percent. By the 5th decade, about 2,800 acres of grassy openings would be provided, an increase of about 37 percent. The 0-10 year-old forest discussed in regard to white-tailed deer would also be provided. Continuing the Standard from the 1985 Plan of leaving three snags per acre would provide potential cavities for nesting. Based on recent analysis (USDA Forest Service 2000), such changes in habitat condition may not alter populations of eastern bluebird. Eastern towhee in this alternative is specifically associated with 0-10 year old forest, brushy fields, and small open areas. This habitat is similar to that provided for the eastern bluebird but without the snag/cavity dependence. Based on recent analysis (USDA Forest Service 2000), there is some potential for such habitat change to reduce eastern towhee populations on the DBNF.

Older age forest management indicator species in this alternative include pileated woodpecker, eastern gray squirrel, and red-cockaded woodpecker. Pileated woodpecker is specifically tied to old-growth timber in this alternative. Old-growth timber is defined as decadent trees of at least 20 inches dbh, in stands with two distinct canopy layers and a crown closure of about 70 percent. Snags at least 22 inches dbh are also required. These conditions are generally provided in oak forest over 130 years old and mixed mesophytic forest over 100 years old. In the first decade of the 2004 Forest Plan, about 78,200 acres in this condition would be provided, an increase of about 100 percent. After five decades, about 186,800 would be available, an increase of about 380 percent. This change in habitat would be expected to lead to an increase in population numbers of pileated woodpecker. Eastern gray squirrel, a game species, is specifically tied to older aged forest capable of producing mast and providing den trees, cavities, and other appropriate nesting sites. The 1985 Plan roughly defined this as oak dominated forest of more than 50 years of age. In the first decade of the 2004 Forest Plan, about 200,900 acres of forest meeting these criteria would be available for habitat, a decrease of about five percent. After five decades, about 208,400 acres of this habitat would available, about two percent less than current conditions. This change in habitat would not be expected to alter the

DBNF's gray squirrel population. The red-cockaded woodpecker, a federally listed endangered species, is specifically tied to older yellow pine trees, in particular, shortleaf pine. At present, this habitat no longer exists on the DBNF, and the species is considered extirpated from Kentucky. After the first decade of the 2004 Forest Plan, about 20,800 acres of yellow pine, primarily shortleaf pine, would be present in the 0-10 year old condition, about 16 times the current amount. After five decades, about 46,800 acres would be available, an increase of about 38-fold. However, none of this would be suitable habitat until the 7th or 8th decade of the 2004 Forest Plan. Red-cockaded woodpecker habitat may be provided in the long-term but not the short-term.

An analysis of population and habitat trends for the above MIS from 1985 to 2000 (USDA Forest Service 2000) concluded that only eastern towhee and eastern gray squirrel served well as ecological indicators. Therefore, a new MIS list with eastern towhee as an ecological indicator and white-tailed deer as a game species, but not an ecological indicator, was used to develop alternatives for the 2004 Forest Plan. Eastern gray squirrel was not included as an MIS for lack of an effective means to monitor the species. To enable the comparison of the draft alternatives with Alternative A, the MIS developed for the alternatives were considered under the direction contained in Alternative A.

Restoration of pitch pine, an MIS species, is not likely under this alternative, and the species may not be represented after five decades except for scattered individuals established through natural regeneration. Acadian flycatcher, a riparian MIS species, would have the same relative amount of riparian habitat as currently found, but there would be increased amounts of open and structurally diverse habitat compared to present conditions. Prairie warbler, an MIS associated with young yellow pine stands would be provided for in this alternative. What populations could be compared to current conditions remains unknown because their response to the southern pine beetle epidemic is not fully understood. Pine warbler, an MIS dependent on older southern yellow pine (70-80+ years), would not be provided for in the first five decades. In the long-term, 7 to 8 decades from implementation, this alternative would provide for the pine warbler. In any case, this species may persist in low numbers between remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland, along with chipping sparrow and northern cardinal, MIS associated with woodland and wooded grassland/shrubland, would not be specifically provided for under this alternative. This alternative, which represents continuation of the 1985 Plan, also would not provide the woodland or wooded grassland habitat components for the MIS northern bobwhite quail. Incidental habitat for these species might be scattered across the forest, however. Black-throated green warbler, Cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for in this alternative, with about a two percent increase in habitat acreage after one decade. A decrease in this habitat of about eight percent would result after five decades. This reduced habitat could be expected to result in slightly fewer numbers of at least some species associated with this habitat condition. Acres of forest capable of producing mast would decrease about five percent in the first decade and by the 5th decade the reduction would be only two percent. The change in this habitat condition is likely to result in only small changes in populations of species dependent on mast. About 15,000 acres of thinning of forest stands would occur in each decade, which should result in a forest with more varied and complex vertical and horizontal structure. Nearly the entire amount represents an increase over current conditions. Cerulean warbler and other species may benefit from this structural change. Habitat for the MIS prairie warbler would be provided at a level above the existing condition, about 16 times current after one decade, and about 38 times current after five decades. Grassland habitat for the MIS field sparrow would increase about four percent in this alternative after one decade and about 37 percent higher after five decades.

Young age forest habitat for the MIS eastern towhee and yellow-breasted chat would decrease about 11 percent under this alternative through the 5th decade. The MIS white-tailed deer was selected as a game species MIS. As such, it is not specifically tied to any particular habitat condition. But it should benefit from the variety of habitat conditions that would be provided under this alternative.

CUMULATIVE EFFECTS

For Alternative A, older stands on state and national park areas would help balance the variety of forest ages and conditions within the proclamation boundary. Young age forest on the state wildlife management area and private lands would increase the relative amount of this habitat within the proclamation boundary. Wildlife openings on the state wildlife management area would increase the relative amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary.

OTHER EFFECTS

No other effects from implementing this alternative are expected beyond those indicated for all alternatives above.

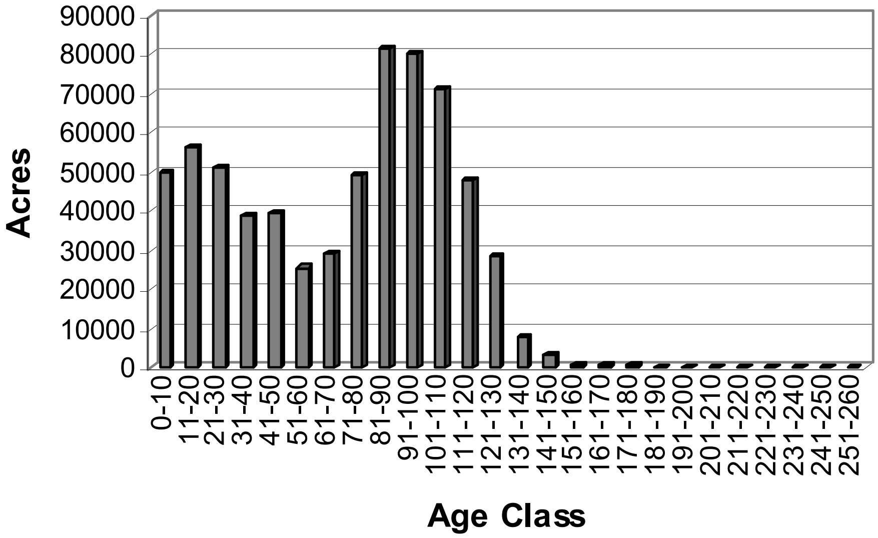

Figure 3 - 23. Alternative A, 1st decade 10-year Age Class distribution

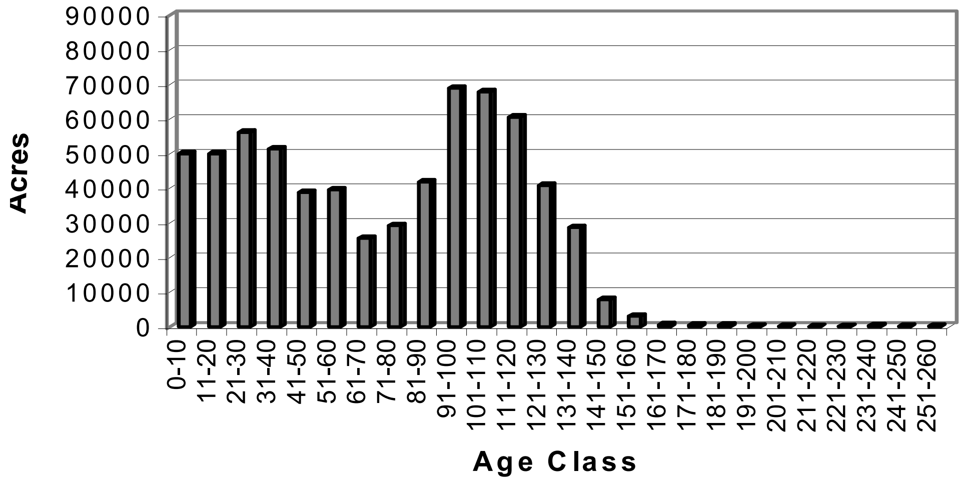

Figure 3 - 24. Alternative A, 2nd decade 10-year age class distribution.

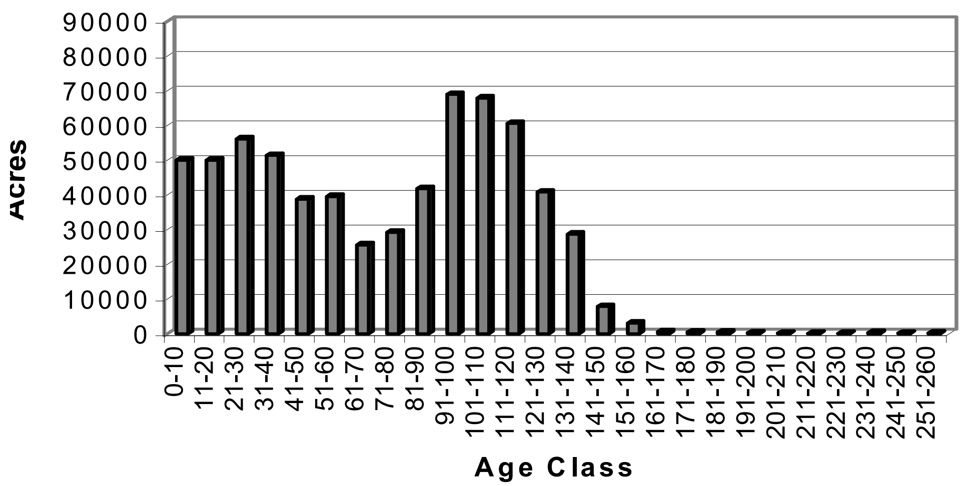

Figure 3 - 25. Alternative A, 5th decade 10-year age class distribution.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Alternative B-1 would schedule about 700 acres of forest regeneration each year. This would involve harvesting 260 acres per year from hardwood or northern conifer forest types. The rest would come from yellow pine restoration efforts, which might not include timber harvest. Compared to existing condition on the ground, this alternative would decrease the total number of acres in young age forest about 88 percent in the first decade. Compared to the actual 0-10 age class created from management action in the last 10 years (ca. 18,400 acres), this alternative would decrease these acres by about 62 percent in the first decade. This reduction of habitat is expected to decrease populations of species that depend on it. In the first decade, the amount of forest in the 60-130 year-old range Figure 3 - 26, Figure 3 - 27, and Figure 3 - 28) would increase about three percent, and by the fifth decade it would decrease about 26 percent. Compared to current levels, some population decrease among species associated with this habitat condition could occur by the fifth decade. Acres of forest capable of producing hard mast would be decreased about four percent over the next decade, but increased about 39 percent by the end of the fifth decade. As a result of both management action and changes following the southern pine beetle epidemic, the actual amount of 0-10 age class currently on the Forest is close to the amount prescribed under Alternative A. In the short-term, little change would be expected in populations of mast dependent species. There is potential for great increase by the fifth decade, however.

Some changes in the relative amounts of forest communities would be expected. As the forest ages in this alternative, the likelihood of natural succession replacing the oak component would increase. Shade tolerant tree species would be expected to increase in the midstory and overstory, eventually replacing some oak stands. Over time, this effect could counteract smaller increases in acres with mast production potential, growing up from younger age classes. Prescribed fire would be utilized in this alternative, primarily to help restore and maintain a yellow pine community on the DBNF. Application of prescribed fire would increase herbaceous diversity in many areas and help maintain the open conditions of woodlands and wooded grasslands/shrublands. About 8,700 acres of southern yellow pine, of which about 1,000 acres would be pitch pine, would be replanted over the next two decades in areas decimated by the southern pine beetle. About 21,800 acres of southern yellow pine, of which about 3,000 acres would be pitch pine, would be replanted over the five decades in areas decimated by the southern pine beetle. The increase in 0-10 year old yellow pine, about 260 percent in each of the next five decades, is expected to promote populations of species that utilize this habitat. Another 750 acres of wooded grassland/shrubland would be created and held through the second decade. These acres are shown in the 0-10 year old age class in the figures and tables in this section. In addition, 2,870 acres of hardwood woodland would be created and held into the second decade. If sufficient pine were available, up to 500 acres of yellow pine woodland would be established by the end of the second decade. These acres are included in forest acres in the figures and tables in this section. Any acres in woodland and wooded grassland/shrubland would represent increases over the current condition. This change in habitat conditions is expected to increase the population numbers of some associated species or at least improve individual health. About 900 acres of grassy openings would be maintained in each of the first five decades for species requiring grassland habitat. This represents a decrease of 59 percent over current conditions. This change in habitat conditions is likely to decrease some populations of dependent species. Continuous Inventory of Stand Condition only indicates about 4,004 acres of riparian forest on the ground. However, about

100,000 acres of 100-year flood plain occur on the ground. The Riparian Corridor Prescription area in this alternative provides an effective increase of 38,800 acres (about a 39% increase) in management for riparian values over the current condition (Table 3 - 34). This increase in management emphasis is expected to result in increases in populations of species associated with riparian habitat.

Restoration of pitch pine is specifically addressed in this alternative and would be represented on the ground after one decade and through the fifth decade. In addition to using the existing riparian habitat, Acadian flycatcher, a riparian species, could take advantage of areas managed for riparian-associated species. Populations of this species could be expected to increase. Prairie warbler, an MIS associated with young yellow pine stands would be provided for in this alternative. Because their response to habitat damage by the southern pine beetle epidemic is not fully understood, just how future prairie warbler populations would compare to current conditions is unknown. Pine warbler, an MIS dependent on older SYP (70-80+ years), would not be provided for in the first five decades, but this alternative would provide for the species long-term, 7 to 8 decades from implementation. This species may persist in low numbers in remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland as well as the chipping sparrow and the northern cardinal, MIS associated with wooded grassland/shrubland, would be provided for at minimum levels, but still at levels above the current condition. Populations of these species could be expected to increase slightly above current levels. The yellow pine woodland and wooded grassland habitat components utilized by the MIS, northern bobwhite quail, would be provided in this alternative, but not until the fifth decade. However, the species might be present in scattered patches of warm-season grass habitat. Any woodland and wooded grassland/shrubland would represent an increase from current conditions. As these habitat conditions increased under this alternative, small population increases of associated species could also be expected. Black-throated green warbler, cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for in this alternative. Their habitat would increase about 13 percent during the first decade and about 42 percent through the end of the fifth decade. These increases are expected to increase populations of MIS associated with this habitat condition. About 1,825 acres of thinning of forest stands would occur in each decade, which would result in a forest with more varied and complex vertical and horizontal structure. Most of this would represent an increase over current conditions. Cerulean warbler and other species may benefit from this structural change. Field sparrow, an MIS associated with grassland, would be provided for only at minimum levels under this alternative. Grassland habitat for these species would be reduced about 59 percent over the current acreage, and populations of associated species would be expected to decrease. Eastern towhee and yellow-breasted chat, MIS associated with young-age forest, would be provided for under this alternative, but at minimum levels. Habitat for these species would be reduced about 62 percent, and a corresponding decrease in these MIS populations would be expected. The white-tailed deer was selected as a game species MIS. While not specifically tied to any particular habitat condition, as a species it benefits from a variety of habitat conditions. Because this alternative would foster habitat less diverse than in current conditions, slightly reduced deer populations could result. The various habitat conditions provided in this alternative should, however, provide useable habitat for the species.

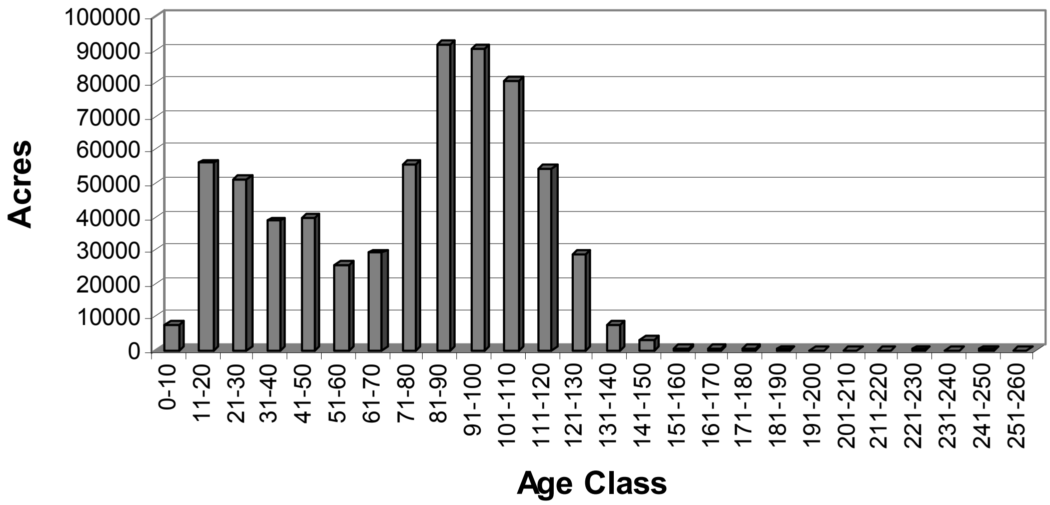

Figure 3 - 26. Alternative B-1, 1st decade 10-year Age Class distribution

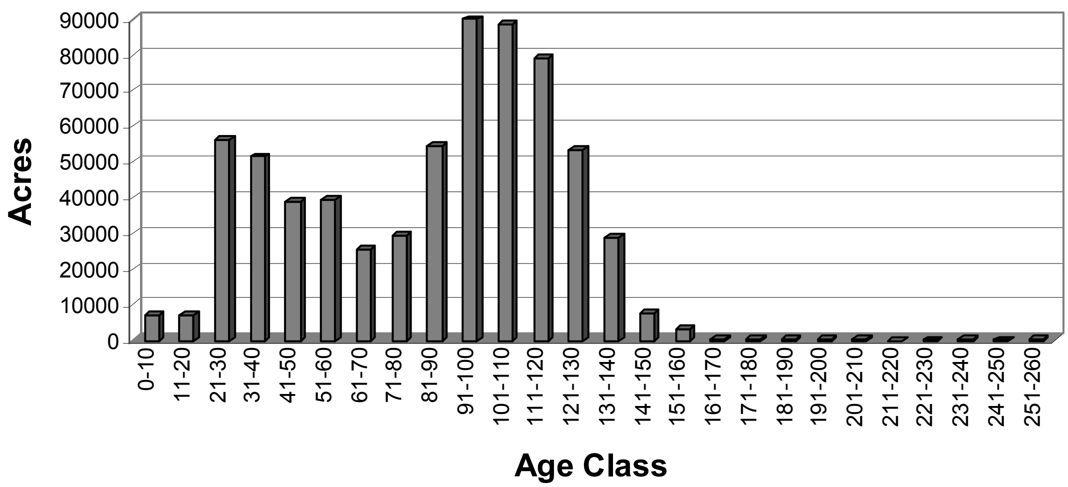

Figure 3 - 27. Alternative B-1, 2nd decade 10-year Age Class distribution.

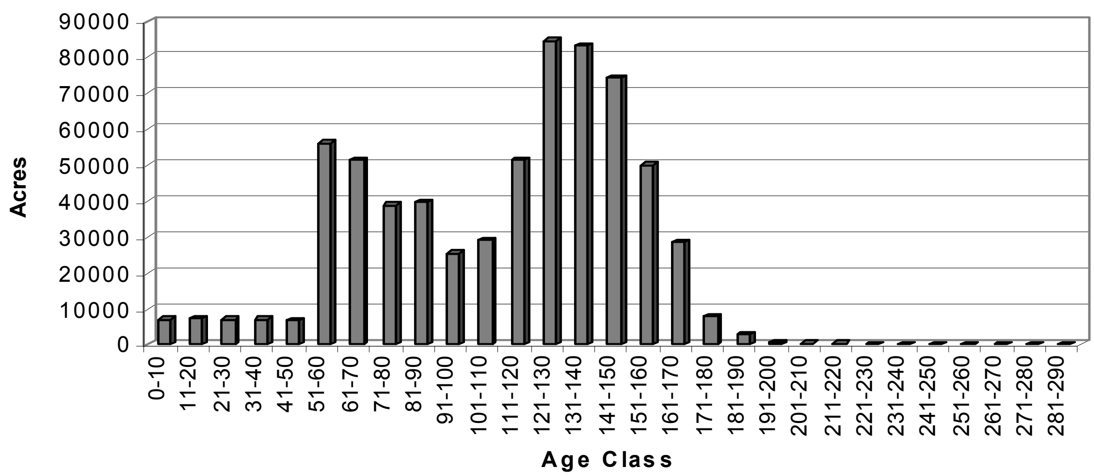

Figure 3 - 28. Alternative B-1, 5th decade 10-year Age Class distribution.

CUMULATIVE EFFECTS

Under Alternative B-1, older timber stands on state and national park land would contribute to a generally older forest condition within the proclamation boundary. Timber harvest on private land or the state wildlife management area may create young age forest conditions supplementing the amount provided by this alternative for young age forest MIS. Wildlife openings on the state wildlife management area would increase the amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary. Reasonably anticipated changes in relative abundance of habitat across the proclamation boundary would be largely the result of management action on National Forest System land.

ALTERNATIVES C, C-1 AND D

DIRECT AND INDIRECT EFFECTS

Alternatives C, C-1, and D would schedule about 2,300 acres of forest regeneration per year. Of this about 1,480 acres per year during the first two decades would be associated with the harvest of hardwood and northern conifer forest types. The remainder would be part of the general yellow pine forest restoration and might not include timber harvest. Compared to current conditions, this alternative would decrease the total number of acres in young age forest about 60 percent in the first decade. Compared to the actual 0-10 age class created from management action in the last 10 years (ca. 18,400 acres), this alternative would increase these acres by about 21 percent in the first decade. As a result of both management action and changes following the southern pine beetle epidemic, the actual amount of 0-10 age class currently on the Forest is close to the amount prescribed under Alternative A. This habitat change is expected to decrease populations of associated species. In the first decade, the amount of forest in the 61-130 year old range would increase by less than one percent and then decrease about 32 percent by the end of the fifth decade. In the first decade, no population changes in species associated with this habitat would be expected. In the fifth decade, however, reductions in populations of some species associated with this habitat condition would be expected (Figure 3 - 29, Figure 3 - 30, and Figure 3 - 31). Acres of forest capable of producing hard mast would be reduced over current levels by less than one percent in the first decade. By the end of the fifth decade, an increase of about 20 percent could be expected. Populations of species dependent on hard mast production would be likely to increase by the end of the fifth decade.

Changes in relative amounts of forest communities would be expected. The oak-dominated forest component should persist. Silvicultural activities including tree cutting and prescribed fire would help maintain oak on the DBNF. The use of prescribed fire should also contribute to the restoration and maintenance of a diverse herbaceous flora as well as woodlands and wooded grasslands/shrublands. About 8,400 acres of southern yellow pine, of which about 1,000 acres would be pitch pine, would be replanted over the next two decades in areas decimated by the southern pine beetle. About 40,200 acres of southern yellow pine, of which about 3,000 acres would be pitch pine, would be replanted over the next five decades in areas decimated by the southern pine beetle. The increase of 0-10 year old yellow pine over current conditions, an increase of 260 percent over current in each of next five decades, can be expected to support increased populations of associated species.

About 1,440 acres total of wooded grassland/shrubland would be created over the next two decades. Over five decades, this amount would expand to about 11,530 acres. These acres are shown in the 0-10 year old age class in Figure 3 - 29, Figure 3 - 30, and Figure 3 - 31. In addition, about 25,400 acres of woodland (about 25,300 acres hardwood) would be created through the first two decades. Over five decades, about 40,100 acres of woodland would be created. These are included in “forest acres” in Table 3 - 34. Any acres in woodland and wooded grassland/shrubland would represent increases from current conditions. These habitat changes can be expected to support increased populations of some associated species. About 2,200 acres of grassy openings would be maintained each of the first five decades for species requiring grassland habitat This represents an increase of less than one percent over current conditions. This change is not likely to result in any decrease in populations of species dependent on grassland conditions. CISC only indicates about 4,004 acres of riparian forest on the ground. However, about 100,000 acres of 100-year floodplain occur on the ground. The Riparian Corridor Prescription area in this alternative provides an effective increase of 38,800 acres (about a 39% increase) in management for riparian values over the current condition (Table 3 - 34). This increase in management emphasis is expected to result in increases in populations of species associated with riparian habitat.

Restoration of pitch pine, an MIS specifically addressed in these alternatives, would be represented on the ground after one decade and through the fifth decade. Acadian flycatcher, a riparian MIS, would be able to use existing riparian habitat and expand into areas managed for riparian-associated species increasing its population on the DBNF. Prairie warbler, an MIS associated with young yellow pine stands, would be provided for under these alternatives. How its population would compare to current numbers is unknown because its response to habitat decimated by the southern pine beetle epidemic is not fully understood. Pine warbler, an MIS that depends on older southern yellow pine (70-80+ years), would not be provided for in the first five decades, but these alternatives would provide for this species long-term, 7 to 8 decades from implementation. This species may persist in low numbers in remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland, as well as chipping sparrow and northern cardinal, MIS associated with wooded grassland/shrubland would be provided for under these alternatives.

The yellow pine woodland and wooded grassland habitat component utilized by the MIS northern bobwhite quail would be provided under these alternatives, but not until the fifth decade. However, the species would likely be present in scattered patches of warm season grass habitat. Any amount of woodland and wooded grassland/shrubland created would represent an increase over current conditions. Black-throated green warbler, Cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for under these alternatives. About 9,000 acres of thinning of forest stands would occur in each decade, resulting in a forest with more varied and complex vertical and horizontal structure. This would all be an increase beyond existing conditions. Cerulean warbler and other species could benefit from this structural change. The grassland habitat for the MIS field sparrow provided under these alternatives would represent a decrease of about 12 percent from current conditions. Habitat provided for the MIS eastern towhee and yellow-breasted chat by these alternatives would represents an increase of 20 percent over current conditions. The MIS white-tailed deer was selected as a game species MIS. While it is not specifically tied to any particular habitat condition, this species benefits from a variety of habitat conditions. The varied habitat conditions provided under these alternative should include useable habitat for the species.

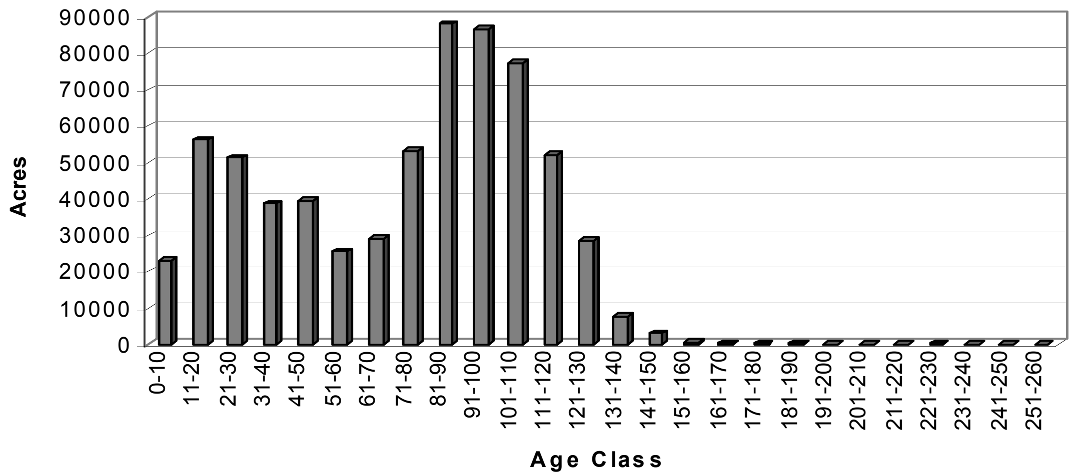

Figure 3 - 29. Alternatives C, C-1, D; 1st decade 10-year Age Class distribution

Figure 3 - 30. Alternatives C, C-1, D; 2nd decade 10-year Age Class distribution.

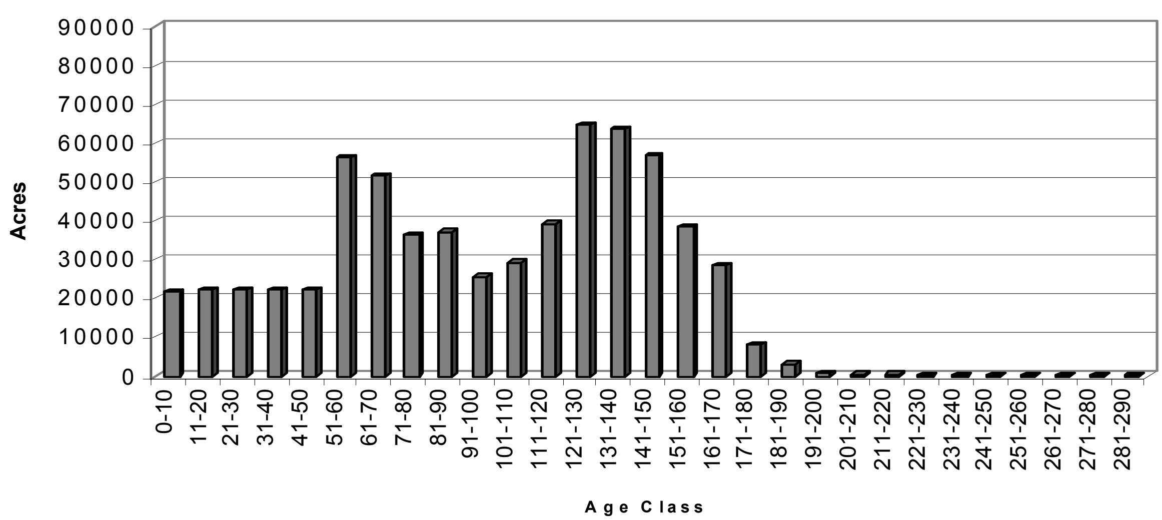

Figure 3 - 31. Alternatives C, C-1, D; 5th decade 10-year Age Class distribution.

CUMULATIVE EFFECTS

Timber harvest on private lands or the state wildlife management area could create young age forest conditions supplementing the amount provided under these alternatives for young age forest management indicator species. Grassy openings on the state wildlife management area would increase the amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary. Reasonably anticipated changes in relative abundance of habitat within the proclamation boundary would be largely the result of management action on National Forest System land.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Alternative E-1 would schedule about 3,600 acres of timber harvest per year (36,000 acres per decade). Of this amount, 3,200 acres per year would come from the timber harvest of hardwood and northern conifer forest types. Compared to existing conditions on the ground, this alternative would decrease the total number of acres in young age forest about 35 percent in the first decade. Compared to the actual 0-10 age class created from management action in the last 10 years (ca. 18,400 acres), this alternative would increase these acres by about 98 percent in the first decade. As a result of both management action and changes following the southern pine beetle epidemic, the actual amount of 0-10 age class currently on the Forest is close to the amount prescribed under Alternative A. This change in habitat from current conditions is expected to result in increases of populations of species associated with this habitat. In the first decade the amount of forest in the older forest, particularly in the 61-130 year old range increases about four percent in the first decade and decreases about 37 percent by the end of the fifth decade. In the first decade, no change to populations of species associated with this habitat is expected. In the fifth decade, reductions in the populations of some species associated with this habitat condition would be expected (Figure 3 - 32, Figure 3 - 33, and Figure 3 - 34). Acres of forest capable of producing hard mast will be reduced over current levels about three percent in the first decade. By the end of the fifth decade, an increase of about six percent is expected. Species dependent on hard mast production may have slight increases in population numbers by the end of the fifth decade.

Changes in relative amounts of forest communities would be expected. The oak-dominated forest component should persist on the landscape. Silvicultural activities including tree cutting and some prescribed fire would help maintain the oak on the DBNF. The use of prescribed fire will also contribute to the restoration and maintenance of a diverse herbaceous flora on the DBNF, and woodlands and wooded grasslands/shrublands. About 8,700 acres of southern yellow pine, of which about 1,000 acres would be pitch pine, would be replanted in southern pine beetle decimated areas over the next two decades. About 21,800 acres of southern yellow pine, of which about 3,000 acres would be pitch pine, would be replanted in southern pine beetle decimated areas over the next two decades. Another 750 acres total of wooded grassland/shrubland would be created and held through the first five decades. This acreage is shown in the 0-10 age class in charts. In addition, about 3,700 acres total of woodland would be created and held through the two decades (about 2,000 acres of hardwood woodland). Through the fifth decade, this would increase to about 4,300 acres. These acres are included in “forest acres” in charts. All acres in woodland and wooded grassland/shrubland are increases from current condition. The change in these habitat conditions is expected to increase population numbers of some species associated with them. About 900 acres of grassy openings would be maintained in each of the first five decades for species requiring grassland habitat. This represents a decrease of about 59 percent over current conditions. This change is likely to result in the decrease of some populations of species dependent on these conditions. CISC only indicates about 4,004 acres of riparian forest on the ground. However, about 100,000 acres of 100-year flood plain occur on the ground. The Riparian Corridor Prescription area in this alternative provides an effective increase of 38,800 acres (about a 39% increase) in management for riparian values over the current condition (Table 3 - 34). This increase in management emphasis is expected to result in increases in populations of species associated with riparian habitat.

Restoration of pitch pine is specifically addressed in this alternative and would be represented on the ground after one decade and through the fifth decade. Acadian flycatcher, a riparian species, would have adequate habitat in this alternative. Prairie warbler, an MIS associated with young yellow pine stands would be provided for in this alternative. It is not known what populations will be like compared to current condition, as their response to the southern pine beetle epidemic is not fully understood. Pine warbler, an MIS dependent on older SYP (70-80+ years), would not be provided for in the first five decades, but the alternative provides for the species long-term, in 7-8 decades from implementation. This species may persist in low numbers in remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland, and chipping sparrow and northern cardinal, MIS associated with wooded grassland/shrubland, would be provided for at minimum levels, but still at levels above the current condition. The yellow pine woodland and wooded grassland habitat components utilized by the MIS northern bobwhite quail would be provided in this alternative, but not until the fifth decade. However, the species would likely be present in scattered patches of warm season grass habitat on the DBNF. All woodland and wooded grassland/shrubland represents an increase from current condition. Black-throated green warbler, cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for in this alternative. In the first decade, it increases about five percent and is about two percent higher than current conditions in the fifth decade. No increase in populations of species associated with this habitat condition is expected. About 22,500 acres of thinning of forest stands would occur in each decade, which will result in a forest with more varied and complex vertical and horizontal structure. All thinning acres represent an increase from current conditions. Cerulean warbler and other species may benefit from this structural change. Grassland habitat for the MIS field sparrow would be provided at a level reduced about 59 percent from current conditions. Eastern towhee and yellow-breasted chat would be provided for in this alternative. Habitat for these species would be reduced about 35 percent over current acreage. The MIS white-tailed deer was selected as a game species MIS. As such it is not specifically tied to any particular habitat condition. As a species, it benefits from a variety of habitat conditions on the landscape. The various habitat conditions provided in this alternative should provide useable habitat for the species.

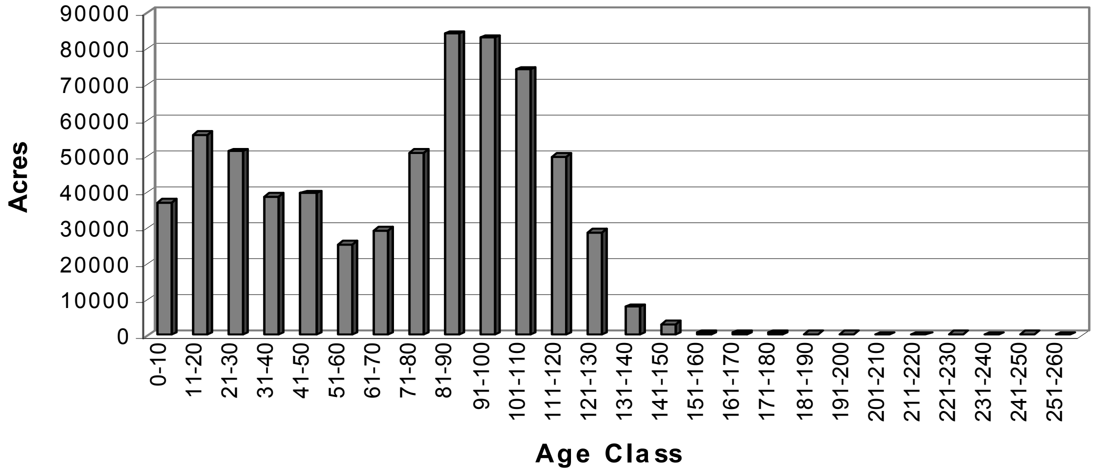

Figure 3 - 32. Alternative E-1, 1st decade 10-year Age Class distribution

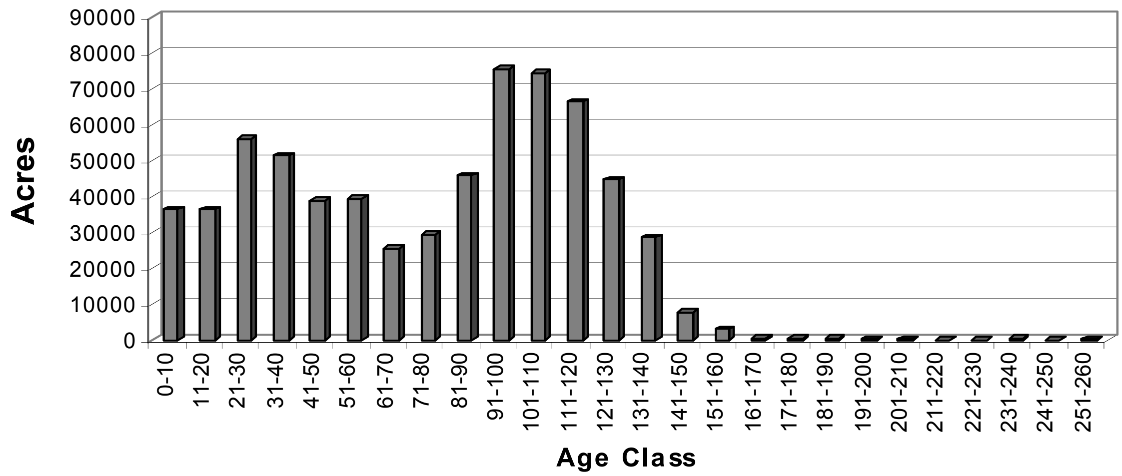

Figure 3 - 33. Alternative E-1, 2nd decade 10-year Age Class distribution.

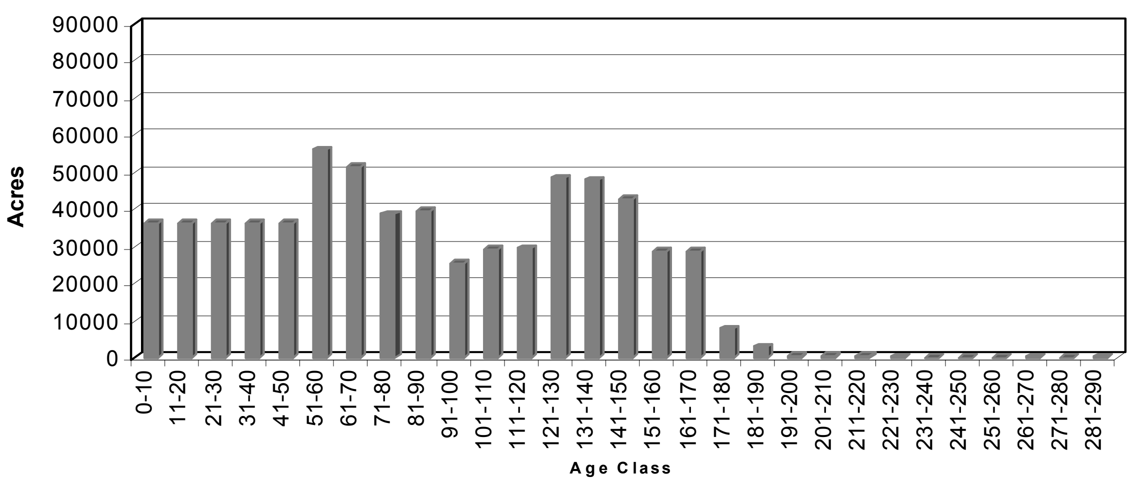

Figure 3 - 34. Alternative E-1, 5th decade 10-year Age Class distribution.

CUMULATIVE EFFECTS

For Alternative E-1, older stands on state and national park lands would help to balance a variety of forest ages and conditions within the proclamation boundary. Timber harvest on private land or the state wildlife management area may create young age forest conditions supplementing the amount provided by this alternative for young age forest MIS. Wildlife openings on the state wildlife management area would increase the amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary. Reasonably anticipated changes in relative abundance of habitat across the proclamation boundary will be largely the result of management action on National Forest System land.

OTHER EFFECTS

No other effects from implementation of Alternatives B-1, C, C-1, D or E-1, beyond those already indicated for all alternatives, would be expected.

FOREST HEALTH

Affected Environment

There are many views of what constitutes a healthy forest. For the purposes of this analysis, forest health is defined as: "the perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance – note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time" (Helms 1989).

Below are listed a variety of items considered when determining the relative health of a forest:

- Dead standing trees
- Broken limbs in trees
- Holes in trees
- Dying trees
- Woody debris on the forest floor
- Dense numbers of trees
- Sparse numbers of trees
- Large old trees
- Small young trees
- Gaps in the forest canopy
- Grassy openings
- Ability to ward-off insect infestation or disease
- Presence of particular species
- Absence of particular species
- Fire scars on trees
- Presence of invasive species

To some observers, dead, dying, and down trees are evidence of poor forest health while others view them as evidence of cyclical diversity. Each characteristic listed above, and others, can be viewed as indicating either good or bad forest health, depending on an observer's frame of reference and on the scale from which they are making their observation. Differing perspectives of a healthy forest can be correct, depending on such factors as scale, location, and management goals.

Diversity is one way to account for all of the characteristics mentioned above. Biological diversity, often abbreviated as biodiversity "refers to the diversity of life in all its forms and all its level of organization, not just the diversity of plant, animal, and microorganism species" (Hunter 1990, p. 7). Richness (number of forest types) and evenness (distribution of abundance among different forest types) provide some indication of diversity. For the purpose of this analysis, the number of forest types present on the Forest will be a measure of richness, and the abundance of each forest type will be a measure of evenness. By managing for diversity, we manage for all life forms endemic to the area. Stability (sustain over time) is another reason to promote diversity. Diverse ecosystems tend to be more stable than those less diverse (Hunter 1990, p. 7-14).

For the purposes of this analysis, a healthy forest ecosystem would have the following characteristics (Kolb 1994, p.10-15):

- The physical environment, biotic resources, and trophic networks to support productive (based on management goals and objectives) forests during at least some seral stages
- Resistance to catastrophic change and/or the ability to recover from catastrophic change at the landscape level
- A functional equilibrium between supply and demand of essential resources (water, nutrients, light, growing space) for major portions of the vegetation
- A diversity of seral stages and stand structures that provide habitat for many native species and all essential ecosystem processes.

The health of a forest ecosystem is more appropriately assessed at a landscape scale (rather than at a tree or stand scale) and cannot be evaluated in a social vacuum. It depends both on society's objectives for the forest and on the interaction of biotic (including human) and abiotic processes that produce the range of habitats required for continued existence of native species. To appreciate the concept of a healthy forest, two basic facts should be kept in mind. First, forests are composed of many different smaller dynamic units, which have different baseline rates of growth and mortality; these units are dynamic, varying over time depending on changing local biological interactions and physical conditions. Second, native and non-native insect populations and diseases also are dynamic as well as opportunistic; they increase and decrease in response to changing forest conditions.

A summary of forest health indicators used in this analysis appears in Table 3 - 35. These species and conditions are used to compare the alternatives as described in Chapter 2. A discussion of each indicator appears after the table. Many more invasive species are present or potentially could occur on the DBNF. The intent here is to assess forest health using small selection of invasive species.

The Forest Service monitors forest health nationally[5], and in the southeast, forest health is monitored by tracking:

- Trends in watersheds having improved watershed conditions
- The status and/or trends in populations, habitats, and ecological conditions for the red-cockaded woodpecker (associated with shortleaf pine), golden-winged warbler (associated with young-age deciduous forest, mostly at higher elevations), and cerulean warbler (associated with mature deciduous forest)
- Trends in acres at extreme risk from fire, insects, diseases, and invasive species.

[5] United States Department of Agriculture-Strategic Plan, USDA-FS, 2000, p. 16-19.

Table 3 - 35. Indicators Used to Assess the Effects to Forest Health.

Indicator	2002 Status
Richness (measured by number)	
Major forest types	6
Evenness (measured by thousand-acres)	
Xeric oak	40
Mesic oak	267
Pine & pine-hardwood	88
Hardwood-pine	68
Mixed mesophytic	165
Cove conifer	34
Early succession provided	N/A
Non-native Invasive Species	
Gypsy moth[1] (measured by thousand-acres)	
Extreme risk condition	75
High risk condition	82
Moderate risk condition	111
(measured by presence)	
Hemlock woolly adelgid	Nearby
Kudzu (Forest-wide)	Present
Asiatic bittersweet (Morehead & Stanton)	Present
Japanese knotweed (Stearns)	Present
Nepal browntop (Forest-wide)	Present
Musk thistle (Morehead)	Present
Spotted knapweed (London)	Present
Crown vetch (Morehead and London)	Present
Zebra mussel	Nearby
Asian clam	Present
Beech bark disease (measured by presence)	Nearby
Native Insects and Pathogens	
(measured by thousand-acres)	
Southern pine beetle (impacted)[2]	100
Oak Decline & Red-oak borer[3]	
Damaged stands	96
Vulnerable stands	61
Unaffected stands	515
Physical Tree Features	
Fire scars and butt-rot (measured by presence)	Present
Live Crown Ratio[4] (measured by percent)	Unknown
Overstory Vegetation	
Older age trees[5] (measured by thousand-acres)	308
Tree density[6] (measured by tree density)	Unknown

[1]Gypsy Moth risk rating is based on an analysis of data from the Forest's corporate database, CISC (Continuous Inventory of Stand Condition). The attribute data (forest type, condition class, site index, and age) from CISC was summarized using the CISC Risk Rating For Gypsy Moth model, which was derived from the work of Kurt W. Gottschalk, Research Scientist, and others, USDA Forest Service, Northeastern Research Station, Morgantown, WV Field Office.

[2]High-risk southern pine beetle – Yellow pine forest types, 50 years or older with basal area greater than or equal to 120 square-feet per acre.

[3]Oak Decline risk rating is based on an analysis of data from the Forest's corporate database, CISC (Continuous Inventory of Stand Condition). The attribute data (forest type, condition class, site index, and age) from CISC was summarized using the Oak Decline Risk Rating model, which was derived from the work of Steve Oak, Forest Pathologist, USDA Forest Service, Forest Health Protection, Asheville, NC Field Office.

[4]Live Crown Ratio not available at the landscape scale of a Forest Plan. More appropriately used at the individual tree or stand level.

[5]Older age trees – Trees greater than 80 years old (for this analysis). This is generally the age in the growth cycle of DBNF stands at which the overstory is beginning to slow in periodic annual increment for height, diameter, basal area, or volume. For some tree species this age is considerably less (e.g. Virginia pine, Scarlet oak).

[6]Tree density, also referred to as stocking (overstocked, understocked, adequately stocked) is not available at the landscape scale of a Forest Plan. It is more appropriately used at the stand level.

Analysis Area

For the purpose of assessing how the 2004 Forest Plan would affect forest health, only National Forest System land areas within the proclamation boundary of the DBNF are considered for each alternative. However, due to the distribution patterns of land ownership and regional nature of some non-native pest problems (including gypsy moth and hemlock woolly adelgid) the analysis area is expanded for those pests, as appropriate.

Richness and Evenness

Eastern Kentucky, which includes the DBNF, lies within the Southern Appalachian Hardwood Region, the world's largest contiguous temperate hardwood forest. "Its upland mixed-hardwood stands are diverse ecosystems that have developed in response to a broad array of biotic, abiotic, and anthropogenic forces" (Barrett 1995, p. 173). However, most of the DBNF lies west and north of the richest portions of this forest. Braun (1950) described areas within portions of what is now the Redbird District as rich in woody plants and having a diverse understory, but it still does not compare to places such as the Great Smoky Mountains. The physiographic provinces of the Appalachian Plateau were discussed earlier in this chapter under Description of Ecological Units.

The forests of today are a result of past use and widespread ecological events. Native Americans, prior to arrival of European settlers, often maintained open forests by partial clearing and through the use of fire. Native Americans and pioneers used the forests for food, grazing, fuelwood, shelter, and cleared the forest for crops and fields. Many of the steep slopes cleared for pasture and agriculture were later abandoned, allowing forest cover to return. From 1870 to 1920, extensive logging occurred in response to the demand for the variety of hardwood products then available from the forests (Barrett 1995, p.182).

At times, wildfire was destructive to Appalachian hardwoods. Fire killed young stands and damaged the trunks of larger hardwood trees contributing to decay and lowering timber product quality. Aggressive fire prevention and suppression efforts began in the mid-1930s, minimizing damage to forest products but changing the structure of stands. For example, exclusion of fire contributed to a noticeable decrease in the oak regeneration that would normally follow natural disturbance or timber harvest (Barrett 1995, p.183). During the nineteenth century, widespread tree cutting for settlements, agriculture, and iron ore production took place with little, if any, concern for environmental quality.

Forest diseases, including chestnut blight and Dutch elm disease, also influenced species composition, structure, and spatial distribution. Within 50 years of the 1906 discovery in New York of Cryphonectria parasitica, the causal organism of chestnut blight, the American chestnut was virtually eliminated from its entire natural range as a dominant forest tree. Prior to the blight, chestnut trees were one of the most common forest trees in the eastern United States. The American elm is no longer a major component of eastern hardwood forests as a result of the Dutch elm disease that entered the United States in the 1930s (Smith, W.H. 1970, p.204). "Even with these significant disturbances, the Southern Appalachian Hardwood Region, in which upwards of 130 tree species have been identified, is considered one of the two most important centers of biological diversity in the United States (Barrett 1950, p.184).

Today's forests are mostly "second or third-growth". Tree species common to the DBNF can be grouped into six major forest communities, which are described in Appendix B. The amount of each forest community is presented in this analysis (Table 3 - 35) to provide some indication of the evenness that existed as of 2002. Tree species composition and condition within these forest types will vary from early successional to late successional, from early age to old age, and from densely stocked to sparsely stocked. These conditions are constantly changing as a result of tree growth, management activities and environmental events (i.e., wind, snow, insect and disease). The area (acres) of early seral trees expected as a result of management activities is intended to provide some indication of the richness that existed as of 2002. A summary of stand conditions was not included in this analysis because it is more appropriately considered at the landscape or stand scale.

Native and Non-native Invasive Species

Nationally, the USDA Forest Service Strategic Plan (2000 Revision) identifies a FY 2006 milestone for achieving a five percent decrease in acres at extreme risk from insects and disease. This analysis will assess the risks of gypsy moth and oak decline with the assumption that these estimates would be an indication of risk from other insects and diseases.

(Non-Native) Gypsy moth (European) is a non-native invasive insect intentionally brought to the United States from France to start a silk industry. It was accidentally released in eastern Massachusetts in the late 1860s. Despite many early attempts to halt its spread, by 1994 the gypsy moth had become established in all or parts of 16 states plus the District of Columbia. It continues to spread into uninfested areas (Gypsy Moth Management in the United States FEIS 1995, p.1-4) is a major defoliator of deciduous hardwood forests. It was first introduced from Europe into Massachusetts in 1869, and because the favored host, oak, is widespread in the eastern deciduous forests, it thrived and continues to expand its range west and south each year. By the 1980s, the gypsy moth was established throughout the Northeast (SAMAB 1996). The generally infested, or quarantine area, extends from New England, south into Virginia, west to Ohio, and includes all of Michigan. As the infested area of gypsy moth expands, the frequency of accidental introductions of gypsy moth on the Southern Appalachian Area national forests will increase. Increasing recreational use of national forest lands may increase the number of accidental introductions of gypsy moth on the Daniel Boone National Forest lands. Accidental introductions of gypsy moth may lead to the use of insecticides to eliminate (or eradicate) and prevent the gypsy moth from becoming established on the Forest Currently, the DBNF is outside of the gypsy moth quarantine area however, single male moth captures have been found on the Morehead and London Districts of the DBNF.

The gypsy moth completes a single generation each year. First instar larvae (caterpillars) emerge from egg masses in April or early May. As temperatures increase, the caterpillars leave the egg masses during daylight hours and climb into the forest canopy. Upon reaching the tips of branches, larvae may spin down on silken threads and disperse on the wind. Most larvae are dispersed within the local area, but some may be carried for distances greater than twelve miles (Taylor and Reling 1986). Larvae may repeat this dispersal process several times before settling down to feed. Male caterpillars usually pass through five larval instars (or, growth stages) and females pass through six. Larvae usually complete their development by early to mid-June and seek a sheltered location for pupation. The pupal stage lasts about two weeks at which time the adult emerges. The male adult moth is dark brown and bears several black bands across the front wings and are capable fliers. The female moth is nearly white, with black bands across the front wings. Females cannot fly but they can walk short distances from their site of pupation. Females release a potent sex attractant (pheromone) to allure male moths for mating. Once mated, the female deposits her brood in a single mass of eggs and dies. The egg mass may contain from 75 to 1,000 eggs. Within four to six weeks, embryos develop into larvae within the eggs, over winter and hatch the following spring.

The gypsy moth spreads over relatively short distances by the ballooning of first instar caterpillars on wind currents. The insect also may spread over much greater distances via human transport. Long distance spread occurs by two mechanisms, the transport of caterpillars or the transport of egg masses. People may pick up larvae in infested areas and carry them on their vehicles, belongings, or clothing to uninfested forested areas. The transport of the gypsy moth via egg masses occurs when vehicles, equipment, or household belongings infested with egg masses are brought into an uninfested areas in spring as the caterpillars are hatching.

Gypsy moth larvae feed on more than 500 species of trees, shrubs, and vines. Favored hosts include oak, apple, birch, basswood, witch hazel, and willow. Hosts moderately favored by gypsy moth include maple, hickory, beech, black cherry, elm, and sassafras. Least favored hosts include ash, yellow poplar, American sycamore, hemlock, pine, spruce, black gum, and black locust. Late instar larvae can feed upon tree species that younger larvae avoid, such as hemlock, maple, pine, and spruce. Feeding on less favored host plants usually occurs when high density larval populations defoliate the favored tree species and move to adjacent, less favored species of trees to finish their feeding and development. An individual gypsy moth caterpillar consumes the equivalent of approximately one square meter (10.75 square feet) of foliage during its development. A typical upland oak forest has 2.5 - 4.5 square meters of foliage per square meter of ground surface area. Thus, the feeding of a relatively few, healthy caterpillars can result in severe defoliation of oak in a stand.

Defoliation by the gypsy moth may reduce tree vigor, reduce growth of shoots and stem, cause dieback of the crown, trigger a failure of hard mast production, and sufficiently weaken a tree such that it is attacked and killed by wood-boring insects and root decay fungi. Hardwoods in a vigorous condition often can tolerate a year or two of defoliation before canopy dieback becomes pronounced. However, hardwoods that are stressed by drought, oak decline, or some other factor tolerate defoliation less well. The damage caused by gypsy moth feeding in spring is harmful because trees must draw upon reserve carbohydrates and nutrients to produce a second canopy of leaves following defoliation (a process referred to as refoliation). Generally, a tree refoliates when approximately 60 percent of its canopy is consumed. Production of a new set of leaves following defoliation restores the photosynthetic capability of a tree's canopy, however, the refoliation process draws upon nutrient reserves that would be used for shoot growth and foliage production the following spring. The refoliated canopy is not able to fully replace the nutrients and stored reserves mobilized by the tree during refoliation, leaving the tree in a weaker condition the following spring. As a result, trees exposed to repeated defoliation and refoliation are weaker and more susceptible to attack by wood-boring insects and root-decay fungi.

In the generally infested area or quarantine area where populations are treated to protect foliage, gypsy moth population densities fluctuate widely from year to year resulting in episodes of dramatic and severe defoliation followed by periods of relative innocuousness. At low densities, the gypsy moth is regulated, but not eliminated, by natural enemies such as parasitic insects and predaceous vertebrates, particularly small mammals. As populations increase beyond the control of these natural enemies, the gypsy moth is regulated by different mortality factors, primarily diseases and starvation. Of these two factors, diseases caused by the nucleopolyhedrosis virus (gmNPV) and the gypsy moth fungus (Entomophaga maimaiga) lead to the collapse of outbreak populations of gypsy moth. At the forest stand level, the period between outbreaks may range from 2 to 5 years and the actual outbreak period may range from 1 to 3 years. On a region-wide basis, gypsy moth populations develop to outbreak levels across wide areas of the northeast, mid-Atlantic, and Lake States for a period of years and then drop to very low levels for several years. Factors regulating these regional outbreaks and collapses of gypsy moth populations are not well understood.

In response to concerns that the U.S. Department of Agriculture (USDA) was not adequately addressing the apparent increase in spread rates over the past three decades (Liebhold and others 1992), the USDA Forest Service (FS) in cooperation with Animal and Plant Health Inspection Service (APHIS); the states of Michigan, West Virginia, Virginia, and North Carolina; and the National Park Service, embarked on a pilot project called "Slow the Spread" (STS). The STS goal is to determine the feasibility of reducing the rate at which gypsy moth is currently spreading, by comprehensively implementing integrated pest management strategies over large geographic areas in the transition zone. As of this writing, evaluation of the STS project indicated that estimated spread rates significantly declined from an average of 26.5 km/yr prior to 1990 to 8.6 km/yr after 1990 (Sharov and Liebhold 1998) and STS has been integrated into USDA's national management strategy for gypsy moth.

Gypsy Moth Slow the Spread

Assuming the gypsy moth spreads at a rate of approximately 12 miles per year, it is expected to reach the Daniel Boone National Forest within 3 to 13 years (2005 to 2015). "Slow the Spread" is a national strategy designed to impede the spread of the gypsy moths by preventing low-density populations from becoming established and/or rapidly increasing. Slow the Spread employs intensive monitoring and aggressive management of gypsy moth populations that are increasing within the transition area (50 to 100 miles ahead of the front). The objective is to delay the impacts and costs associated with gypsy moth outbreaks and suppression. Figure 3 - 36 shows a projection of gypsy moth spread with the Slow the Spread strategy in place and without the Slow the Spread strategy.

States neighboring Kentucky to the east and northeast (Ohio, West Virginia, and Virginia) have suffered from defoliation caused by the gypsy moth (Table 3 - 36). These states are active in suppression efforts as described in the Gypsy Moth Environmental Impact Statement 1995 (Forest Health Protection 2002a, p.7).

Table 3 - 37 displays the results of annual monitoring of gypsy moth traps in high-use areas of the DBNF.

Isolated male gypsy moths have been captured, apparently arriving here while attached to vehicles that traveled from gypsy moth infested areas. At present there are no known reproducing populations in Kentucky.

Table 3 - 36. Aerially detected gypsy moth defoliation, 1996-2000.

STATE	1996	1997	1998	1999	2000
Ohio	49,000	5,000	1,600	48,200	23,600
Virginia	0	0	0	0	71,000
West Virginia	70,700	500	800	0	323,100
14 Other States	80,000	41,800	360,900	476,600	1,205,800
Total	199,700	47,300	363,300	524,800	1,623,500

(Forest Health Protection 2002a, p.7)

Table 3 - 37. Results of gypsy moth pheromone trapping on the DBNF, FY-2001.

District	Pheromone Trapping No. & Sex of Moths Captured	Delimited Grid Trapping No. & Sex of Moths Captured
Morehead	1 – Male	Not trapped
Stanton	0	Not trapped
London	1 – Male	0
Somerset	0	Not trapped
Stearns	0	Not trapped
Redbird	0	Not trapped

A gypsy moth risk rating system has been developed for use with the Continuous Inventory of Stand Conditions (CISC) maintained by the DBNF. This risk rating system was developed by entomologists at the Forest Health Protection field office in Asheville, NC. The model utilizes variables such as Forest Type, Condition Class, Site Index (a measure of site productivity) and Age to assign a risk to each stand. Risks are categorized as Unaffected, Low, Moderate, High, or Extreme. This model was applied to the Daniel Boone National Forest CISC information. Currently, approximately 23 percent of National Forest System land on the DBNF is at high to extreme risk of suffering damaged or death from gypsy moth attack. Figure 3 - 35 displays the existing condition pertaining to these gypsy moth risks. The spread of gypsy moth is projected in Figure 3 - 36.

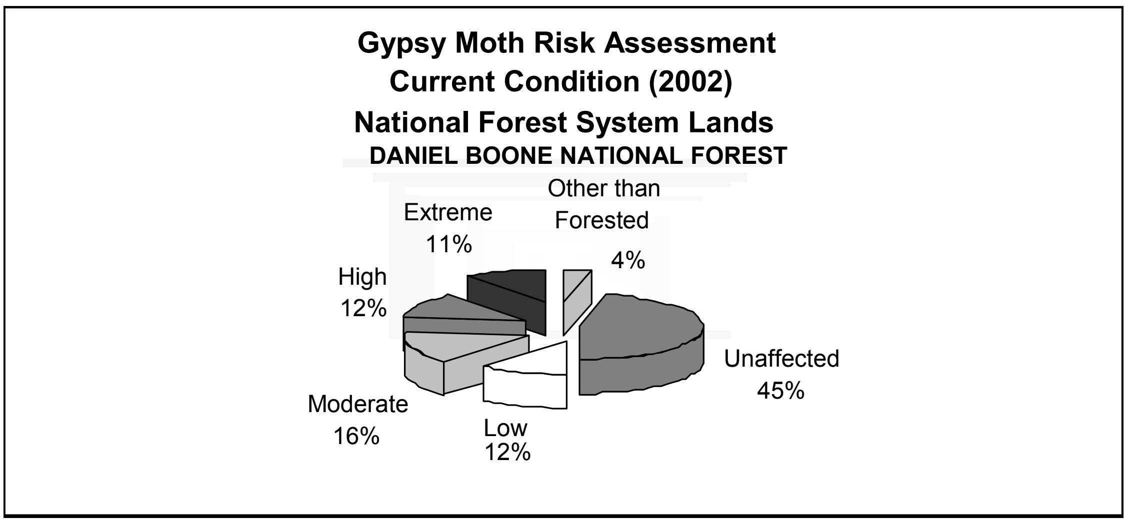

Figure 3 - 35. Gypsy moth risk assessment for the Daniel Boone National Forest.

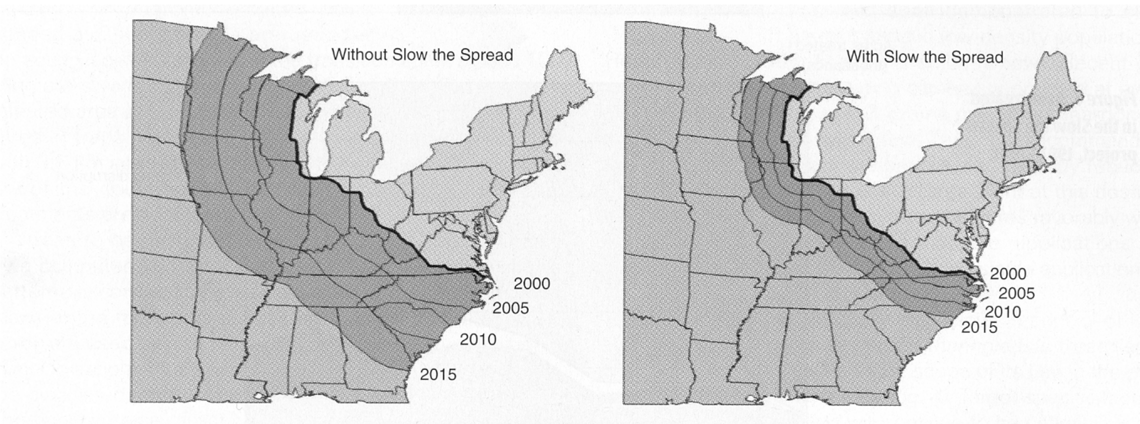

Figure 3 - 36. Projected gypsy moth spread in the Eastern United States. (Sharov et al. 2002, p. 34).

(Non-native) Hemlock woolly adelgid was brought to the eastern United States near Richmond, Virginia from Asia in 1927. The adelgid was present on some non-native tree species that a private collector planted in his arboretum. Distribution remained localized until the 1960s. The population has since spread west throughout the Shenandoah Valley into the Blue Ridge Mountains of Virginia, south into North Carolina, South Carolina, and Tennessee and north into the northeastern United States. Impacts can be severe. The entire range of eastern and Carolina hemlock could become infested within 30 years. Any hemlock tree is vulnerable, regardless of aspect, site conditions, or tree age. Once infested, tree mortality usually occurs in less than seven years. Considering known locations of the adelgid, it is expected to spread into Kentucky within the next 3 to 5 years (2005 to 2008).

(Non-native) Kudzu was introduced into the United States at the Philadelphia Centennial Exposition in 1876 where it was used as an ornamental, covering walkways and running through trellises. It was also recommended as a forage plant at that time. It was not until 1933 that the Soil Erosion Service (later named the Soil Conservation Service and now the National Resources Conservation Service) began distributing kudzu as a soil stabilizer (approximately 85 million plants were distributed). In 1953 the U.S. Department of Agriculture removed kudzu from its listings of cover plants, and in 1970 listed it for the first time as a common weed in the South.

(Non-native) Asiatic or oriental bittersweet is a deciduous woody vine that climbs by twining about a support. It is native to temperate East Asia, including central and northern Japan, Korea, and China north of the Yangtze River. Bittersweet appears to have been introduced to eastern North America around 1860. It is especially troublesome in the southern Appalachians. Its North American habitat preferences are wide but seem to be exclusively terrestrial. It is variously described as occupying open woods and thickets, roadsides, fencerows, and alluvial woods (Dreyer 1994). At present, oriental bittersweet is known in several small areas on the Morehead and Stanton districts.

(Non-native) Japanese knotweed is native to eastern Asia. It was introduced from Japan to the United Kingdom as an ornamental in 1825 and to North America in the late nineteenth century. Its early emergence and height growth combine to shade out other vegetation and prevent regeneration of other species. It does not appear to be a threat in undisturbed forests or in other low-light areas. If unchecked, it will likely continue to expand its range in open habitats (Seiger 1991). Currently, Japanese knotweed has been located only on the Stearns district.

(Non-native) Nepalese browntop is also commonly referred to as Japanese grass or Eualia. An annual grass native to Asia from India, Japan, China, Korea, and Malaysia, it was first identified in the United States in 1919. It grows quickly, fruits within a single season, produces abundant seed, and easily invades disturbed areas, including areas disturbed by water along streams. Tolerant to shade, it does not persist in areas of full sunlight. Once established, however, it is difficult to eradicate (Tu, undated). Nepalese browntop has been found Forestwide.

(Non-native) Musk thistle, native to Europe and Asia, arrived in the United States during the mid-1800s. Musk thistle is most prevalent in disturbed areas and native grasslands (Heibel 1987). Musk thistle has been found on the Morehead district.

(Non-native) Spotted knapweed a native of Europe was accidentally introduced to North America in the 1890s in alfalfa seed from Asia Minor (Mauer et. al. 1987). Spotted knapweed tolerates shade but invades grasslands, displacing native grasses. Knapweed has been found on the London district.

(Non-native) Crown vetch is native to Europe, southwest Asia and northern Africa. Crown vetch is widely distributed throughout the northeastern United States, mostly from being planted along highways. Primarily a species of open, disturbed sites, it tolerates light to moderate forest shade. Currently, crown vetch has been found on the Morehead and London districts.

(Non-native) Zebra mussel, native to Eastern Europe, first entered the United States in the mid 1980s. Currently, zebra mussels have been found in Lake Cumberland.

(Non-native) Asian clam, a native of Asia, was introduced to North America around 1920 in the northwest. Since then, it has invaded nearly every major river system in the United States and is found throughout the DBNF.

(Native) Southern pine beetle, a native species, is a threat to shortleaf, pitch, and Virginia pine trees. Beginning in 2000, several Appalachian states with southern-yellow pine trees experienced extremely high populations of the southern pine beetle (Table 3 - 38). This will likely be known as one of the largest such outbreaks in the history for this region.

Table 3 - 38. Acres (thousands) of Southern Pine Beetle outbreaks, 1996-2000*.

STATE	1996	1997	1998	1999	2000	2001
Kentucky	0	0	0	0	220	100,000
13 Other States	7,301	8,477	6,820	6,159	11,912	Unknown
Total	7,301	8,477	6,820	6,159	12,132	

*Based on change detection analysis using satellite imagery. USDA Forest Service 2002a, p.7

As the southern pine beetle populations expanded the DBNF, southern-yellow pine trees died at an alarming rate. The infestation did not begin as individual spots that progressed across the landscape, but rather as thousands of widespread spots that expanded in all directions. Suppression efforts were largely ineffective. Even isolated southern-yellow pine trees, eastern white pine, and hemlock trees became infested and died. By 2002, populations of predator beetles were on the increase, and a noticeable decrease in southern pine beetle activity was evident.

The southern pine beetle infestation and massive tree loss has altered nearly 100,000 acres of upland stands in which southern-yellow pine was a component. Observations by field-going personnel indicate that individual live pine trees remain scattered across the landscape. Planting efforts can restore the southern-yellow pine component, but in the absence of human intervention, hardwoods are replacing dead pine trees.

(Native) Oak decline is a concern for upland hardwood forests throughout the Appalachian range. Stand and site factors that determine oak decline risk include forest type (oak density), site productivity (site index), age, and stress factors such as spring defoliation and drought. Red oaks are especially vulnerable. The red-oak borer is a contributing factor in widespread, severe mortality due to oak decline in Arkansas and could become a danger in Kentucky because of similar forest types and stand conditions. Approximately 36 percent (250,000 acres) of the National Forest System lands on the DBNF have upland forest types at risk of oak decline. Thirty-nine percent (96,000 acres) can be classified as damaged, 24 percent (61,000 acres) can be classified as vulnerable, and 37 percent (93,000 acres) can be classified as unaffected.

(Native) Oak Decline and Red-oak Borer: Oak decline is the culmination of three groups of interacting factors. The first group, termed *predisposing* factors, includes advanced physiologic age, tree species composition, tree density, and soil attributes. The second group, or *inciting* factors, includes drought and spring defoliation by frost or insects such as the gypsy moth or fall cankerworm. The third group is *contributing* factors such as armillaria root disease (caused by *Armillaria mella* (Vahl.) Quel.), two-lined chestnut borer, and the red oak borer. While contributing factors often appear to be the proximal cause of tree mortality in oak decline events, predisposing and inciting factors set the stage for the action of opportunistic pathogens and insects that infect the roots and girdle stems of vulnerable trees.

(Non-Native) Beech bark disease, a disease complex resulting from the interaction of multiple insect and fungus species that has caused extensive mortality of American beech in the northeastern United States. Beech bark disease results in mortality especially of large, old beech trees and heavy sprouting of highly susceptible stems that creates a stunted thicket growth of poorly-formed trees termed the "aftermath forest." Wounds created by feeding of the primary scale insect, Cryptococcus fagisuga, create infection courts suitable for colonization by several native and non-native species in the genus Neonectria (Primary native fungus is N. galligena and the primary non-native fungus is N. coccinea var. faginata.) A number of other related and un-related insects and fungi may be involved in the beech bark disease complex. Currently, 3,000 acres of forest on the DBNF is at risk to beech bark disease but management for the disease will be impractical until the disease becomes introduced and the relative abundance of resistant trees can be estimated.

Overstory vegetation

Over-mature trees[6] typically have a slower growth rate and less ability to withstand stress events than younger trees. In forest types found on the DBNF, culmination of periodic annual increment generally occurs 80 years after stand establishment. Nearly 44 percent (308,000 acres) of existing forest stands within the DBNF proclamation area have an average tree age of 80 years or greater and this is expected to increase to 58 percent (408,000 acres) over the next 10 years. This abundance of

[6] A tree or stand that is declining in commercial value (see glossary).

over-mature trees will result is an elevated risk of mortality to a number of abiotic and biotic stress events across the landscape.

Tree density

Trees in dense, over-stocked growing conditions typically exhibit lowered radial growth and have poorer live-crown development when compared to trees in fully stocked or open-grown conditions. In dense stands, reductions in photosynthetic potential results in increased susceptibility to stress events such as insect and disease outbreaks until tree mortality naturally thins stands or trees are thinned as part of active management. There are indications that much of the forest may be in an overstocked condition (Alerich 1991). Although current inventory data does not yield accurate estimates of forest densities, future surveys should be able to monitor this condition.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Richness

The six major forest types would continue to be present. None of the alternatives contain direction that would eliminate or add major forest types.

Native and Non-native Invasive Species

Hemlock woolly adelgid: Young and old hemlock trees whether healthy or damaged are equally susceptible to the hemlock woolly adelgid. Hemlock trees dominate a large part of riparian areas across the forest, some as scattered individuals and some as dense stands. While the hemlock woolly adelgid may not move rapidly through the DBNF in the manner of the southern pine beetle, it could still claim thousands of hemlock trees in the long-term. Prescribed fire could eliminate or prevent establishment of hemlock on the slopes where they would be susceptible to attack. Hemlock trees would still likely occur in riparian areas where fire is less intense during prescribed burns. The relative amount of fire among the alternatives would not change when the hemlock woolly adelgid arrives in Kentucky.

Kudzu: Patches of kudzu would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Where action is not taken, kudzu would continue to spread, climbing trees and shrubs and shading out native vegetation. Repeat treatments would be needed to limit growth or eliminate a patch.

Asiatic Bittersweet: Patches of Asiatic bittersweet would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Where action is not taken, Asiatic bittersweet spreads rapidly because of high reproductive rate, long-range dispersal from birds and small mammals, ability to sprout from roots, and rapid growth rate. The twining and climbing action of Asiatic bittersweet causes plants to be overtopped and girdled, resulting in death to plants.

Japanese Knotweed: Patches of Japanese knotweed would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Where action is not taken, Japanese knotweed would remain. It would not invade the forest understory because it requires high light environments for survival. Repeat treatment would be needed to prevent reestablishment.

Nepal Browntop: Patches of Nepal browntop would be monitored and occasionally, suppression activities would occur. Complete eradication is unlikely because it produces abundant seed that remains viable in the soil for up to five years. Nepal browntop can quickly crowd out natural communities, mostly in moist disturbed areas. Repeat treatments would be needed to limit patch growth or to eliminate a patch.

Musk Thistle: Patches of musk thistle would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Musk thistle occurs in disturbed areas such as roadsides and grasslands, crowding out natural communities.

Spotted Knapweed: Like many noxious weeds, initial invasion usually correlates with highly disturbed areas. Once established, it can invade relatively undisturbed areas. Patches of spotted knapweed would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Spotted knapweed has been found in grassland areas that are usually over grazed. Repeat treatments would be needed to limit patch growth or to eliminate a patch.

Crown Vetch: Like many noxious weeds, initial invasion usually correlates with highly disturbed areas. Once established, it can invade relatively undisturbed areas. Patches of crown vetch would be monitored and occasionally suppressed. Complete eradication would be unlikely during the 10 years. Crown vetch has been found in grassland areas. It tolerates light to moderate shade and will survive and spread under open forest cover. Repeat treatments would be needed to limit patch growth or to eliminate a patch.

Zebra mussel: No action would be taken because scientists at present have no means of eradicating zebra mussels.

Southern Pine Beetle: A wide spread infestation of southern pine beetle is unlikely in the next 10 years. Isolated spots may be active from year to year depending on climatic conditions, predator populations, and stress to pine trees.

Asian clam: Asian clams are present throughout the DBNF and no effort would be made to eradicate the species.

Beech bark disease: Age, size, and density of beech trees are factors that determine vulnerability and susceptibility. Beech bark disease is expected to be present on the forest within 10-20 years. Once established, the rate of spread will depend on beech stocking and how well the beech scale is able to spread. Many stands of large, old beech occur in the Upper Kentucky River Management Area, unfortunately, the highest mortality from beech bark diseases occurs with older, larger trees. The general forest trend toward an older-aged forest in all of the alternatives will result in enhanced risk to mortality from beech bark disease. Until beech bark disease becomes established, management for the disease in each alternative is impractical until more knowledge about distribution of resistant trees within the DBNF can be obtained. Prescribed burning is one tool that can be used to control heavy sprouting in beech bark disease-affected stands and to prevent beech from becoming established in new stands.

CUMULATIVE EFFECTS

Richness and Evenness

Outside actions by the private sector or by other agencies are unlikely to change the number or condition of the major forest types on the DBNF.

Native and Non-Native Invasive Species

Non-native invasive species can be transported into the area by vehicles, birds, livestock, equipment, and by people seeding disturbed areas on private land. If these areas are near National Forest System land, there is a chance for invasive species to spread onto the forest. Movement of boats from lakes containing zebra mussels can bring them to uninfested lakes. Vegetation management on private land can affect the presence and populations of insects and disease in the area. Road maintenance along state and federal highways can cause seed to move during grading operations. The differing emphasis on recreation among alternatives could have some impact on the spread of invasive species. Increased out-of-state travel could increase the likelihood of importing invasive species. Arrival of an invasive species could result from a single incident, however, regardless of the emphasis placed on recreation.

Activities in other states to suppress gypsy moth populations would be a factor in determining when the front reaches Kentucky, including the DBNF. Vehicles traveling from gypsy moth infested areas could bring gypsy moth into Kentucky. Gypsy moth occurrences are more likely to occur in developed campgrounds and parking areas. Activities designed to improve tree growth and develop advanced regeneration of oaks on National Forest System land, however, would not be sufficient to replace the aging upland hardwood forest types that would be affected by gypsy moth. Activities on private land are unpredictable and are not normally designed to defend against gypsy moth movement.

Physical Tree Features, Including Overstory

Occurrences of wildland fire are unpredictable, mostly a result of arson. The potential for damage to hardwood trees from wildland fire is related to the amount of land burned each year and the conditions at the time of the burn. Quantification of the damage that would be caused by wildfire cannot be predicted accurately.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration following the southern pine beetle infestation, would be expected to occur on approximately 21,000 acres (2,083 acres annually). Prescribed burning would be expected on approximately 150,000 acres (15,000 acres annually), mostly in forest types containing a pine component. These two activities should maintain or restore approximately 25,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession and management activities are expected to contribute toward changes in the vegetative component of the major forest types. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 90,000 acres (9,000 acres annually). These treatments would occur in the 1985 Plan's Management Areas 6 and 7, which encompass approximately 87 percent of the National Forest System land base. In 1985 Plan's Management Areas that are unsuitable for timber production, the tree species composition would move toward densely stocked, late-successional maple and beech.

Native and Non-native Invasive Species

Gypsy moth: By 2012, approximately 54 percent (145,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth infestation. This would be a five percent decrease from the 59 percent (157,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would be implemented to impede the gypsy moth advance by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area (50 to 100 miles ahead of the front) (Gypsy Moth FEIS). Over the 10-year planning period, treatment of approximately 45,000 acres of upland hardwoods currently in the extreme-risk category would fortify them against gypsy moth attack, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (from 157,000 to 189,000) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 22 percent (145,000 acres) of the DBNF would be susceptible (vulnerable or damaged condition) to oak decline, a 2 percent decrease from the 24 percent (157,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning would occur on approximately 15,000 acres over the next 10-years. The water, nutrients, and light available to the remaining trees would offer them the opportunity to increase their crowns and roots. An increased live crown ratio would reduce the strain on trees remaining in thinned areas, improving their ability to withstand stresses induced by invasive species.

The crowns of trees in dense stands not thinned would become smaller as the stands age. Some trees would die because their live crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking and old age.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand. With 15,000 acres burned annually, mostly within the pine-dominated region, little impact to hardwoods would be expected.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration, following the southern pine beetle infestation, would be expected to occur on approximately 4,000 acres (436 acres annually). Prescribed burning would be expected on approximately 20,000 acres (2,377 acres annually), mostly in forest types containing a pine component. These two activities should maintain or restore approximately 5,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession would favor maple and beech. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 10,000 acres (1,000 acres annually). Tree species composition would tend toward densely stocked, late-successional maple and beech on the remainder of the forest.

Native and Non-native Invasive Species

Gypsy moth: By 2012 an estimated 68 percent (181,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth attack, a 9 percent increase from the 59 percent (157,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would be implemented to impede the gypsy moth advance by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area, 50 to 100 miles ahead of the front, (Gypsy Moth FEIS). Over the 10-year planning period, treatment of 9,000 acres of upland hardwoods currently in the extreme-risk category would fortify them against gypsy moth attack, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (157,000 to 189,000 acres) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 27 percent (145,000 acres) of the Forest would be susceptible (vulnerable or damaged condition) to oak decline, a 3 percent increase from the 24 percent (157,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning would occur on approximately 15,000 acres over the next 10 years. The water, nutrients, and light available to the remaining trees would offer them the opportunity to increase their crowns and roots. An increased live crown ratio would reduce the strain on trees remaining in thinned areas, improving their ability to withstand stresses induced by invasive species.

The crowns of trees in dense stands not thinned would become smaller as the stands age. Some trees would die because their live crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking and old age.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire, resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand. With 2,000 to 15,000 acres burned annually, little impact to hardwoods would be expected.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

ALTERNATIVE C, C-1, & D

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration, following the southern pine beetle infestation, would be expected to occur on approximately 8,000 acres (822 acres annually). Prescribed burning would be expected on approximately 150,000 acres (15,000 acres annually). These two activities should maintain or restore approximately 10,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession would favor maple and beech. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 60,000 acres (6,000 acres annually). Tree species composition would tend toward densely stocked, late-successional maple and beech on the remainder of the forest.

Native and Non-native Invasive Species

Gypsy moth: By 2012 an estimated 60 percent (160,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth attack, a one percent increase from the 59 percent (157,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would be implemented to impede the gypsy moth advance by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area, 50 to 100 miles ahead of the front, (Gypsy Moth FEIS). Over the 10-year planning period, treatment of approximately 30,000 acres of upland hardwoods currently in the extreme-risk category would fortify them against gypsy moth attach, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (157,000 to 189,000 acres) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 24 percent (160,000 acres) of the Forest would be susceptible (vulnerable or damaged condition) to oak decline, an increase of less than one percent from the 24 percent (157,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning activities would occur on approximately 15,000 acres over the next 10 years. The water, nutrients, and light would be available to the remaining trees providing them with the opportunity to increase their crowns and roots. The live crown ratio on leave trees in thinned areas would be expected to increase. These conditions reduce the amount of stress to the remaining trees improving their ability to withstand stresses induced from invasive species.

The crowns of trees in dense stands that have not been thinned would become smaller as stands age. Some trees would die because their roots and crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire, resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand. However, with 15,000 to 50,000 acres burned annually, burning would occur in hardwood stands resulting in a noticeable increase in advance oak regeneration and elimination of thin-barked species. This thinning of the forest would encourage root and crown development of remaining trees. Signs of fire, such as basal scarring and possibly open wounds, especially in the younger hardwood stands, would be apparent.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration, following the southern pine beetle infestation, would be expected to occur on approximately 4,400 acres (436 acres annually). Prescribed burning would be expected on approximately 24,000 acres (2,400 acres annually). These two activities should maintain or restore approximately 5,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession would favor maple and beech. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 80,000 acres (8,000 acres annually). Tree species composition would tend toward densely stocked, late-successional maple and beech on the remainder of the forest.

Native and Non-native Invasive Species

Gypsy moth: By 2012 an estimated 48 percent (130,000 to 268,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth attack, an 11 percent decrease from the 59 percent (157,000 to 268,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would impede the spread of the gypsy moth by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also, Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area, 50 to 100 miles ahead of the front, (Gypsy Moth FEIS). Over the 10-year planning period, treatment of approximately 60,000 acres of upland hardwoods currently in the extreme-risk category would be fortified against gypsy moth attack, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (157,000 to 189,000) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 19 percent (130,000/672,000 acres) of the Forest would be susceptible (vulnerable or damaged condition) to oak decline, a 5 percent decrease from the 24 percent (157,000/672,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning would occur on approximately 24,000 acres over the next 10 years. The water, nutrients, and light available to the remaining trees would offer them the opportunity to increase their crowns and roots. An increased live crown ratio would reduce the strain on trees remaining in thinned areas, improving their ability to withstand stresses induced by invasive species.

The crowns of trees in dense stands not thinned would become smaller as the stands age. Some trees would die because their live crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking and old age.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale, making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire, resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

VIABILITY

Affected Environment

The viability of species native to the DBNF or within the influence of the Forest (the proclamation boundary) was addressed in a multiple step process. An extensive list of species found on or near the Forest was developed from literature, sight records, species location databases, consultation with other agencies, and the knowledge of Forest Service personnel. While this inventory includes about 3,800 species, not all species groups, e.g., insects and other arthropods are well represented, because documentation was not always available. At the same time, a list of major habitat associations and rare communities was developed. Then the catalog of species was filtered to identify keystone species and species with uncertain likelihood of continued viability, resulting in a list of 409 species[7]. This list is dynamic and the number of species on it is expected to change with updates of distribution and habitat and population condition data. Species with uncertain likelihood of continued viability are defined as those for which there is a low likelihood of maintaining viable populations within a defined area without management intervention. The National Forest Management Act (NFMA) defines a viable species population as “the estimated numbers and distribution of reproductive individuals to insure its continued existence [and] is well distributed in the planning area so that those individuals can interact” (36 CFR 219.19). Keystone species generally have stable populations and their viability is not of concern, but their existence in the ecosystem helps to ensure that one or more other species maintain viable populations.

Next, a list documenting the habitat relationships of these 409 species was compiled. A list of similar, associated habitats and their associated species was also developed, based on habitat-species relationships. Then, available data were utilized to estimate the types and amounts of habitat necessary to maintain minimum viability, i.e., the smallest population capable of sustaining itself for species with viability concerns. In the case of rarely occurring species this would mean the maintenance of existing populations and their required habitat.

If major habitat associations and rare communities can be maintained, adequate habitat should be available to maintain the viability of most species. Providing general forest type or structure condition, however, does not necessarily supply adequate habitat for every species. Those with highly specific habitats, low population numbers, or other factors potentially reducing the likelihood of continued viability may need closer examination and more precise habitat management.

For this analysis, the “planning area” referred to in the NFMA definition of viability consists of federally owned lands administered by the DBNF. The ability to sustain viable populations of native and non-native species of plants and animals is limited by the capabilities of the land and agency.

Because species and their environments are dynamic, it is not possible to ensure that a species will persist indefinitely. Likewise, there is no single, fixed size of a population above which a species is viable and below which it will become extinct (Boyce 1992), or in the case of the DBNF, extirpated. Consequently, viability is best expressed as a likelihood of continuance of a species in a particular area or the risk of a particular habitat-species relationship not being maintained on the ground.

[7] Consists of PETS and Conservation Species.

TERRESTRIAL SPECIES VIABILITY EVALUATION

National Forest Management Act (NFMA) regulations, adopted in 1982, require that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.19). USDA regulation 9500-004, adopted in 1983, re-enforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native plants, fish, and wildlife. These regulations focus on the role of habitat management in providing for species viability. Supporting viable populations involves providing habitat in amounts and distributions that can support interacting populations at levels that result in continued existence of the species well distributed over time.

The Southern Appalachian region supports extremely high levels of biological diversity compared to other regions, viewed both nationally and globally. As a result, large numbers of species are present for which population viability may be of concern. Detailed demographic or habitat capability analysis to evaluate population viability is not feasible for such a large number of species. Therefore, our goals for this evaluation are:

1) To use a clearly defined, transparent process to identify species for which there are substantive risks to maintenance of viable populations, and
2) To ensure consideration of appropriate habitat management strategies to reduce those risks to acceptable levels where feasible.

For comprehensiveness and consistency, evaluation of species viability was coordinated across several national forests undergoing simultaneous plan revisions. Species lists from the DBNF were compared with lists from the Jefferson National Forest, Cherokee National Forest, Sumter National Forest, Chattahoochee and Oconee National Forests, and National Forests in Alabama. These forests encompass portions of the Southern Appalachian, Piedmont, and East Gulf Coastal Plain ecoregions. However, the scale for this assessment is set by NFMA regulations as the “planning area,” or the area of the National Forest System covered by a single forest plan. Therefore, separate risk assessment was done for each national forest covered by a separate forest plan. Although viability evaluation was coordinated across the ecoregions, analysis presented here focuses on information relevant to the DBNF.

Because NFMA regulations require the provision of habitat for species viability within the planning area, the focus of this evaluation is the habitat provided on National Forest System (NFS) land. Surrounding private lands may contribute to, or hinder, maintenance of species viability on NFS land, but surrounding lands are not relied upon to meet regulation requirements. For this reason, habitat abundance was assessed based on conditions found on NFS land. Habitat distribution, however, was assessed considering the condition of intermixed ownerships and conditions, which may affect the interactions of species among suitable habitat patches on NFS land.

Evaluation of migratory birds focused on breeding populations only, unless otherwise indicated. This focus does not mean that wintering and migrating populations were not considered during planning, but that viability evaluation makes most sense when viewed in terms of the relative stability of breeding populations.

Much of the foundational information used in this evaluation was compiled by NatureServe under a Participating Agreement with the Forest Service. NatureServe is an international non-profit organization, formerly part of The Nature Conservancy. Its mission is to develop, manage, and distribute authoritative information critical to conservation of the world's biological diversity. Partnership with NatureServe was sought as a means to obtain the best available information on species status and habitat relationships for use in this evaluation. Under this agreement, NatureServe staff engaged numerous species experts and state heritage programs to develop a relational database that includes relevant information on species' status, habitat relationships, and threats to viability.

VIABILITY EVALUATION PROCESS

Risk to maintenance of viability over the next 50 years was assessed for each species in relation to each of its principle habitat relationships by alternative. Risk assessment was based on three factors: 1) current species abundance, 2) expected habitat abundance in 50 years, and 3) expected habitat distribution in 50 years (Figure 3 - 37). Once risk ratings were developed, how well management strategies would provide for species viability was assessed by alternative.

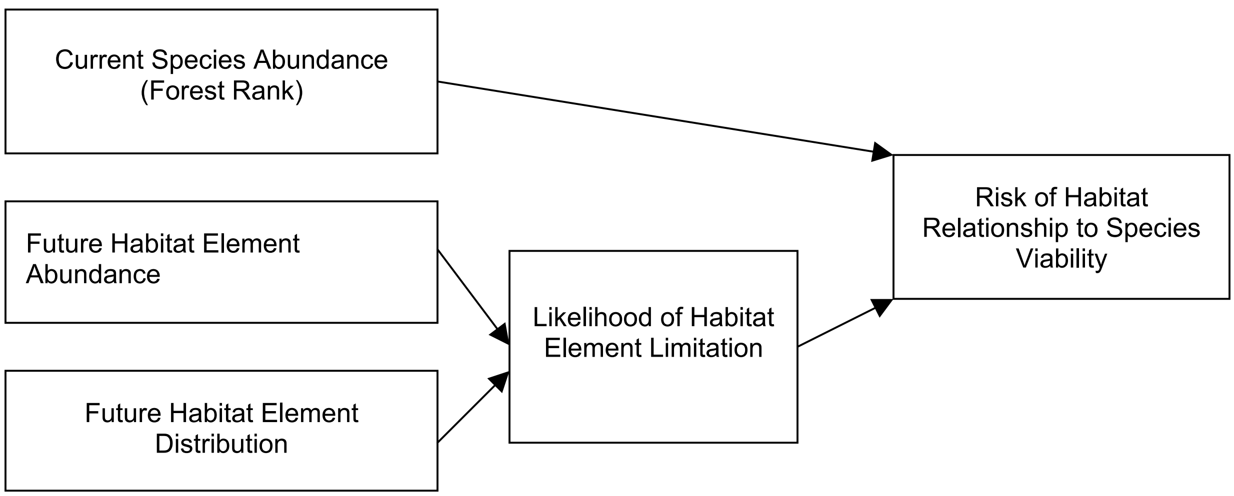

Figure 3 - 37. Relationship of variables used to rate the risk to viability resulting from a species' relationship with a habitat element.

A comprehensive list of species with potential viability concern was compiled for the DBNF. The list includes those species found, or potentially found, on the Forest from the following categories:

1) Species listed as proposed, threatened, or endangered under the federal Endangered Species Act
2) Species listed on the Regional Forester's Sensitive Species list
3) Species identified as locally rare on the DBNF by Forest Service biologists
4) Birds of conservation concern as identified by the U.S. Fish and Wildlife Service
5) Declining species of high public interest.

Species lists from all national forests in the Southern Appalachian, Piedmont and Cumberland Plateau ecoregions, as well as Coastal Plain forests in Alabama, were pooled to create comprehensive lists of species of potential viability concern. NatureServe staff and contractors assigned abundance ranks for each species on the comprehensive ecoregion list for the DBNF. These Forest Ranks, or F Ranks, follow the conventions used by NatureServe and others in defining State and Global Ranks. F Ranks were used in viability risk assessment as a categorical variable representing a species' current abundance. Forest Service biologists reviewed F Ranks developed by NatureServe to identify any inconsistencies between these rankings and Forest Service information. Many discrepancies in this abundance variable were resolved through coordination with NatureServe; however, some differences remain due to disagreement among experts or inconsistencies in source data. Efforts to resolve these differences are ongoing. For this analysis, where conflicting information on species abundance occurs, the most conservative information (i.e., that indicating lowest abundance) was used.

Only those species that are both confirmed present and rare or of unknown abundance (F1 through F3, and F?) on the DBNF were assessed for viability risk. Species ranked as F? were treated as F1 species to provide a conservative approach to those species for which abundance information is not available. Species currently abundant on the forest (F4, F5) are assumed to be at low risk of losing viability within the next 50 years, and, therefore, were not further evaluated for viability risk.

Table 3 - 39. Forest Ranks (F Rank) and definitions used to define status of species on the DBNF as part of species viability evaluation for Forest Plan revision, 2002.

Forest Rank	Forest Rank Definition
F0	Not present; no known occurrences on the Forest unit, and Forest is outside species' range or habitat not present.
F1	Extremely rare on the Forest unit, generally with 1-5 occurrences.
F2	Very rare on the Forest unit, generally with 6-20 occurrences.
F3	Rare and uncommon on the Forest unit, from 21-100 occurrences.
F4	Widespread, abundant, and apparently secure on the Forest unit.
F5	Demonstrably secure on the Forest unit.
F?	Present on the Forest, but abundance information is insufficient to develop rank.
FP	Possibly could occur on the Forest unit, but documented occurrences are not known.
FH	Of documented historical occurrence on the Forest unit; may be rediscovered.
FX	Once occurred but has been extirpated from the Forest unit; not likely to be rediscovered.

Because viability regulations focus on the role of habitat management in providing for species viability, habitat condition was the primary factor used to drive species viability evaluation. NatureServe staff and contractors identified habitat relationships for all species of potential viability concern, linking each species to vegetation community types, forest age, and habitat attributes as appropriate. Based on this information, each species was linked by Forest Service biologists to one or more habitat elements. These habitat elements (Table 3 - 40) roughly correspond to categories of management direction included in the Proposed Revised Forest Plan, and to sections of effects analysis included in this draft environmental impact statement (DEIS). NatureServe staff reviewed and provided adjustments to species' assignment to these habitat element groups.

Table 3 - 40. Habitat elements used to plan for, and assess risk to, viability of terrestrial species during DBNF Forest Plan revision.

HABITAT ELEMENT	ELEMENT DESCRIPTION
Bogs, Seeps, Seasonal Ponds	Bogs, seeps, seasonal ponds characterized by saturated soils
Open Wetlands	Open wetlands, marshes, beaver ponds, generally characterized by having some permanent standing water (includes swamps)
River Channels	Riverine gravel and sand bars, and river banks subject to flood scour
Glades and Barrens	Glades and barrens characterized by shallow soils, exposed parent material, and sparse or stunted vegetation
Rock Outcrops and Cliffs	Rock outcrops and cliffs characterized by exposed rock, shallow soils and sparse vegetation
Spray Cliffs	Rock that remains wet for all or most of the year, associated with waterfalls or seepage
Canebrakes	Canebrakes characterized by dense stands of cane and open canopies, usually within riparian areas
Caves	Caves with microclimates capable of supporting associated biota
Dry-Xeric Cedar Oak Forest	70+ year old redcedar and mixed oak forest with open midstory and understory.
Mature Forests (General)	70+ forest of any type
Mature Mixed Mesophytic Forests	70-140+ year old mixed mesophytic (cove) forest, characterized by calciphilic herbs and usually dominated by sugar maple, American basswood, and yellow buckeye
Mature Hemlock Forests	80-140 year old + eastern hemlock and eastern hemlock-white pine forests in native settings, typically on stream terraces and other mesic sites
Mature/ Old-Aged Beech Forests	Forests dominated by 80 year old + American beech, usually in coves or riparian areas
Mature Mesic-Xeric Oak Forests	Mesic to xeric 70-120 + year old oak and oak-yellow pine forests subject to moderate levels of disturbance (fire) sufficient to maintain the oak component
Mature Yellow Pine and Mixed Yellow Pine-Oak Forests	70-120 year old southern yellow pine and pine-oak forests maintained in open conditions by frequent fire
Mature Pitch Pine Forests	70-120 year old pitch pine or pitch pine-mixed yellow pine-oak forests, primarily on ridges and along cliffs. Maintained in open conditions by frequent fire
Mature High Elevation Mesic Hardwood (Pine Mtn.)	70+ year old mesic hardwoods at 2300 ft elevation or higher
Mature Forest Interiors	Mature forest interiors with minimal adverse effects due to forest edge.
Mid-Aged Forest	Forest 11-60 years old, often with high stem density
Young Age Forests	Young age forests, typically aged 0-10 years and dominated by woody species
Young Age Yellow Pine and Mixed Yellow Pine-Oak Forest	Young age yellow pine and yellow pine-oak forest, typically 0-10 years old and dominated by woody species.
High Elevation Early-Aged Forest (Pine Mtn.)	Young age forest at 2300 ft elevation or higher
Canopy Gaps	60-140 year old mesic, deciduous, and 60-120 + year old dry-mesic oak forests with a diverse vertical and horizontal structure as a result of gaps in the canopy
Woodland	Open, moderate basal area with either grass/forb or low shrub understory
Wooded Grassland/Shrubland	Open, low basal area with either grass/forb or low shrub understory
Grass/Forb Woodlands and Wooded Grasslands	Open woodlands and wooded grasslands characterized by low canopy cover and species rich, grass-dominated understories, and maintained in open conditions by periodic fire
Grasslands	Grasslands with little to no overstory, usually occurring as patches within woodland and wooded grassland complexes and maintained by periodic fire
Fire Adapted/Enhanced	Species promoted by fire or fire maintained conditions
Riparian (General)	Riparian forest, open or closed and a variety of understory conditions
Open Midstory and Understory	Forest, generally mid-aged or older in which the midstory and understory are open and often sparse
Dense High Shrub Understory	Forest, generally mid-aged or older in which the understory is thick with woody species 6-10 ft tall
Mature/ Old-Aged Riparian	Riparian areas dominated by 70-120 year + deciduous and mixed conifer-hardwood forests
Young Age Riparian	Riparian areas with a dense understory or young age forest in riparian areas
Snags	Forests containing an abundance of snags
Den Trees	Trees with small to large cavities in which species may winter, seek protection or house young
Old-Aged Forest with Dead/Dying Large Trees	120-150 year old + forest characterized by having numerous large dead (snags) or dying trees
Downed Wood	Forests containing an abundance of downed wood and thick leaf litter
Hard Mast	Forests producing abundant hard mast
Lakeshores, Large Reservoirs	Forested shores of lakes
Pond Shore	Shores of ponds, usually grassy or shrubby
Water (Distance Sensitive)	Source of free water is needed with a specific distance during the entire year or specific portions of the year

Effects to these habitat elements are analyzed in this DEIS under other sections. Based on these analyses, each habitat element was assigned categorical values by alternative to indicate:

1) Future abundance (Table 3 - 41) and distribution (Table 3 - 42)
2) General likelihood that the habitat element would limit viability of associated species (Table 3 - 43)
3) Overall effect of national forest management on the habitat element (Table 3 - 45).

The future abundance variable (Table 3 - 41) is defined as the likely abundance of the associated habitat element in 50 years if the alternative were selected and implemented over that 50-year period. This variable indicates the abundance of the habitat element on National Forest System land only, to provide focus on the role of the national forest planning area in supporting associated species. Definitions of abundance categories are stated in quantifiable terms in order to be objective as possible; however, in many cases quantifiable estimates of future abundance are not available. In these cases, knowledge of Forest Service biologists was used to assign abundance values based on current conditions plus the magnitude and direction of effects expected under each alternative.

Table 3 - 41. Values used to categorize projected abundance of each habitat element after 50 years of implementing each alternative.

Habitat Abundance Value	Description
Rare	The habitat element is rare, with generally less than 100 occurrences, or patches of the element generally covering less than 1 percent of the national forest planning area.
Occasional	The habitat element is encountered occasionally, and generally is found on 1 to 10 percent of the national forest planning area.
Common	The habitat element is abundant and frequently encountered, and generally is found on more than 10 percent of the national forest planning area.

Similar to the future abundance variable, the future distribution variable (Table 3 - 42) is defined as the likely distribution of the associated habitat element in 50 years if the alternative were selected and implemented over that 50-year period. In contrast to the abundance variable, it includes consideration of intermixed ownership patterns and conditions, as well as their general effects on movements and interactions of individuals among the suitable habitat patches found on NFS land.

The number of species to be evaluated is very large, and the knowledge level required to assess habitat adequacy for most species is not available. However, habitat distribution can be assessed in historical terms. Conditions that existed prior to the major perturbations associated with European settlement of the planning area, generally defined as 1000 to 1700 A.D., provide this reference. This approach assumes that habitat distribution similar to that which supported associated species during relatively recent evolutionary history will likely contribute to their maintenance in the future. Accordingly, the viability risk of associated species rises as habitat departs from that historical distribution.

This approach has its own set of difficulties because evidence of pre-1700 conditions relevant to the planning area is scarce and often anecdotal. Some evidence does support the past occurrence of yellow pine forests as well as yellow pine and hardwood woodlands, wooded grasslands/shrublands, and smaller grasslands in the past 2,000 to 3,000 years on what is now the DBNF and adjacent areas (Campbell et al. 1991, Novi and Waldrop 1991, Delcourt et al. 1998, Delcourt, 2002, Owen 2002).

However, the extent of such habitats is not easily determined. The DBNF has a taken an adaptive approach plan for limited acreage in this planning cycle while projecting long-term, larger amounts (see Vegetation Cover section). In addition, the reference period may have included a wide variety of conditions as a result of growing aboriginal populations and accompanying use of agriculture and fire during the early portion of this period, and their subsequent dramatic decline due to disease epidemics following early European contact. Nevertheless, the precision required to assign the categorical values for this variable is not High, and may be supported by general positions described in mainstream conservation literature (see discussions in Baker and Hunter 2002; Owen 2002; Trani-Griep 2002). Knowledge of Forest Service biologists was used to assign distribution values, based on interpretations of historical conditions supported by conservation literature and current conditions, as well as magnitude and direction of effects expected under each alternative.

Table 3 - 42. Values used to categorize projected distribution of each habitat element after 50 years of implementing each alternative.

HABITAT DISTRIBUTION VALUE	DESCRIPTION
Poor	The habitat element is poorly distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches is greatly reduced.
Fair	The habitat element is fairly well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches is somewhat reduced.
Good	The habitat element is well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches is similar to or only slightly reduced relative to reference conditions.

Habitat element abundance and distribution variables were combined to create one variable to indicate the general likelihood that the habitat element would be limiting to populations of associated species (Table 3 - 43). In this general context, habitat limitation refers to a habitat factor -- quantity, distribution, or quality -- that results in risk to continued existence of the species within the planning area. Everything else being equal, quality habitat elements that are rare and poorly distributed are those most likely to cause risk to viability of associated species; those that are common and well distributed are least likely to cause risk to viability of associated species.

Table 3 - 43. Likelihood of habitat limitation (High, Moderate, and Low) to associated species as derived from habitat abundance and distribution values.

HABITAT ABUNDANCE	HABITAT DISTRIBUTION		
	Poor	**Fair**	**Good**
Rare	High	High	Moderate
Occasional	High	Moderate	Low
Common	Moderate	Low	Low

Providing for species viability requires providing abundant and well-distributed habitat in ways that allow existing populations to persist or expand. The ability of existing populations to respond to available habitat depends in part on their current robustness, which is generally a function of population size. In general, for a given habitat condition, small populations will be at more risk than large populations. To reflect this fact, the "likelihood of habitat limitation" variable was combined with a species' F Rank for each species/habitat element interaction to generate viability risk ratings (Table 3 - 44). Associations of very rare species with habitat elements that are likely to be most limiting were identified as those most at risk; associations of more common species with habitats less likely to be limiting received lower risk ratings.

Table 3 - 44. Viability risk ratings for species/habitat interactions as a function of a species' F Rank and likelihood of habitat element limitation variables.

Likelihood of Habitat Element Limitation	Species F Rank		
	F1 or F?	F2	F3
High	Very High	High	Moderately -High
Moderate	High	Moderately-High	Moderate
Low	Moderately-High	Moderate	Low

Once viability risk ratings were developed for each species/habitat relationship, habitat elements most commonly associated with risks to species viability were identified by counting the number of Very High, High, and Moderately High ratings associated with each. To assess the role of national forest management in minimizing viability risk associated with each habitat element, a management effects variable was assigned to each habitat element by alternative. The management effects variable (Table 3 - 45) categorizes the goal of management for the habitat element, the expected resulting trend, and any additional opportunity for minimizing viability risk. Numbers of Very High, High, and Moderately-High risk ratings were summarized by management effects variable by alternative to assess how well alternatives address viability-related habitat needs.

Table 3 - 45. Values used to categorize the effect of national forest management in minimizing or contributing to species viability risk associated with each habitat element.

MANAGEMENT EFFECT VALUE	DESCRIPTION
1	Abundance and distribution of the habitat element is maintained or improved by providing optimal protection, maintenance, and restoration to all occurrences (with limited exceptions in some cases). Little additional opportunity exists to decrease risk to viability of associated species because management is at or near optimal. Pertains largely to inherently rare habitat elements.
2	Abundance and distribution of the habitat element is improved through purposeful restoration, either through active management or passively by providing for successional progression. Opportunity for decreasing risk to associated species is primarily through increasing rates of restoration, where possible. Pertains largely to potentially widespread habitat elements.
3	The habitat element is maintained at approximately current distribution and abundance, though location of elements may shift over time as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to increase abundance and distribution of the habitat element.
4	Regardless of management efforts, the habitat element is expected to decrease in distribution and abundance as a result of factors substantially outside of Forest Service control (e.g., invasive pests, acid deposition). Opportunity to reduce risk to viability of associated species is primarily through cooperative ventures with other agencies and organizations.
5	The habitat element is expected to decrease in distribution and abundance as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to maintain or increase this habitat element.

Distribution of viability risk was also summarized by species status, i.e., federally listed under the Endangered Species Act, listed as Regional Forester's sensitive species, identified as locally rare, or of other concern. The species status summary highlights the relative role of other provisions included in law and policy that result in additional consideration of at-risk species during planning.

Viability Evaluation Results

Species viability evaluation for the DBNF included consideration of about 3,800 species of the Cumberland Plateau ecoregion. Of these species, 266 from the Cumberland Plateau ecoregion are considered rare (F Rank of F?, F1, F2 or F3) and are known to occur on the Forest.

Outcomes for habitat elements, as described under individual effects analysis sections, are summarized in Appendix H, Table H - 1, using the four variables described in Table 3 - 41, Table 3 - 42, Table 3 - 43, and Table 3 - 45. These variables indicate expected habitat condition following 50 years of implementing each alternative.

Ratings of risk to viability for each species/habitat relationship by alternative are presented in Appendix H, Table H - 2. To facilitate comparison of effects of alternatives on species viability, the numbers of Very High, High, and Moderately-High risk ratings are summarized for each alternative by habitat element (Table 3 - 46), management effect (Table 3 - 47), and species status (Table 3 - 48).

Viability risk rating summaries indicate relatively small differences among alternatives relative to effects on species viability. This similarity results from planning efforts to include provision in all alternatives for species viability in compliance with NFMA regulations. Examples of such provisions common to all alternatives (except Alternative A, which represents the current forest plan) include the Rare Community Prescription Area and the Riparian Corridor Prescription Area. Similarity of viability outcomes among alternatives also results from the influence of external forest health threats, which represent serious risks to forest communities and associated species regardless of alternative. Differences among alternatives are also muted by the small scale of actions contemplated under all alternatives relative to the more extensive effects to ecological systems that have occurred to DBNF landscapes since European settlement. Broader scale effects will likely continue to have similar important effects to species viability regardless of alternative.

Evaluation results indicate, under all alternatives, that high levels of risk to species viability are associated with certain key habitats (Table 3 - 46). Highest risks are associated with:

1) Bogs, seeps, and seasonal ponds
2) Wetlands
3) Glades
4) Grass/forb woodland or wooded grassland
5) Mature yellow pine and mixed pine-oak forest
6) Mature hemlock-white pine
7) Mature high elevation mesic hardwood
8) Grassland.

Bogs, springs and seeps, and natural seasonal ponds are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to beaver control and drainage for agriculture, and the number of rare species associated with them. The Rare Community Prescription Area should provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative A; therefore, opportunities for further reducing risk to viability of associated species are limited. While such habitats would likely be maintained under Alternative A, they would not receive the focused attention provided by the Rare Communities Prescription Area.

Wetlands, including swamps, natural upland ponds, beaver ponds, and wet meadows are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to beaver control and drainage for agriculture, and the number of rare species associated with them. The Rare Community and Riparian Corridor Prescription areas should provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative A; therefore, opportunities for further reducing risk to viability of associated species are limited. While such habitats would likely be maintained under Alternative A, they would not receive the focused attention provided by the Rare Community Prescription Area. In some cases, artificial wetlands which could be created under any alternative, may provide suitable, but not necessarily optimal habitat.

Glades are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to fire exclusion and changes in the nature and extent of herbivory (animal grazing) within them, and the number of rare species associated with them. The Rare Community Prescription Area should provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative A; therefore, opportunities for further reducing risk to viability of associated species are limited. While such habitats would likely be maintained under Alternative A, they would not receive the focused attention provided by the Rare Community Prescription Area.

Grass/forb woodlands or wooded grasslands are critical to maintaining species viability due their rarity on the landscape, largely the result of changes in fire patterns and frequency on the landscape following both mid-16th century European contact and later settlement; and the number of rare species associated with them. Provisions of the habitat diversity prescription in Alternatives C, C-1 and D provide for the restoration of this habitat on about 10 percent of the DBNF after 50 years, a figure probably below the historical level, but almost in its entirety an increase over current conditions. The Custodial Area Prescription Area of Alternative B-1 and the Timber Production Emphasis Prescription Area of Alternative E-1 would provide for this habitat on less than 1 percent of the DBNF after 50 years. Under Alternative A, such habitats would not likely be restored.

Mature yellow pine and mixed pine-oak forests are critical to maintaining species viability for two reasons. They are naturally limited on the DBNF landscape, and a large number of species is associated with them. A recent outbreak of the southern pine beetle, of unprecedented severity, killed at least 70 percent of the yellow pines in yellow pine and yellow pine-oak forest. Currently this habitat is rare on the Forest. All alternatives provide for the establishment of new yellow pine forests, but none would in 50 years provide mature yellow pine, and none would replace in 50 years the yellow pine acreage lost to the pine beetle epidemic.

Mature eastern hemlock-white pine forests are critical to maintaining species viability because the hemlock component, which is most important, is naturally limited to riparian zones, narrow shaded hollows and high elevations, and represents the edge of range for many associated species. They therefore support large numbers of species of potential viability concern. While their distribution may be somewhat reduced over historical conditions, the greatest threats to this community and associated species are impacts from the hemlock woolly adelgid, an invasive non-native insect expected to be on the DBNF within one to two decades. All age classes of hemlock are susceptible to this insect, and there is currently little which management can do to slow its spread. Additionally, impacts from air pollution may be adversely affecting this habitat; significant broad-scale coordinated efforts are needed to resolve this issue. Although core areas of eastern hemlock-white pine forest would be provided optimal management under both the Riparian Corridor and the Habitat Diversity Prescription Areas, external threats are more likely to determine the fate of this community as well as the viability of associated species. Little opportunity for reducing risks through typical national forest management is apparent.

Mature, high-elevation mesic hardwood forests are critical to maintaining species viability because they are naturally limited to the highest elevations and represent the edge of range for many associated species. They therefore support large numbers of species of potential viability concern. While their distribution may be somewhat reduced over historical conditions, the greatest threats to this community and associated species are impacts from mining, timber harvest, and development. Additionally impacts from air pollution may be adversely affecting this habitat; significant broad-scale coordinated efforts are needed to resolve this issue. Little of this habitat is managed by the DBNF, and a core area does not exist on the Forest. While core areas exist on other lands, external threats are more likely to determine the fate of this community and the viability of associated species. Little opportunity for reducing risks through typical national forest management is apparent.

Table 3 - 46. Number of species/habitat relationships rated as of Very High, High, and Moderately High risk to terrestrial species viability for each habitat element by alternative.

HABITAT ELEMENT		Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Bogs, Springs, Seeps							
Very High		0	0	0	0	0	0
High		27	27	27	27	27	27
Moderately High		15	15	15	15	15	15
	Total	42	42	42	42	42	42
Wetlands							
Very High		8	8	8	8	8	8
High		7	7	7	7	7	7
Moderately High		6	6	6	6	6	6
	Total	21	21	21	21	21	21
Glades and Prairies							
Very High		3	3	3	3	3	3
High		3	3	3	3	3	3
Moderately High		5	5	5	5	5	5
	Total	11	11	11	11	11	11
River Channels							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		17	17	17	17	17	17
	Total	17	17	17	17	17	17

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Spray Cliffs						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Canebrakes						
Very High	0	0	0	0	0	0
High	1	1	1	1	1	1
Moderately High	0	0	0	0	0	0
Total	1	1	1	1	1	1
Caves						
Very High	0	0	0	0	0	0
High	4	4	4	4	4	4
Moderately High	4	4	4	4	4	4
Total	8	8	8	8	8	8
Cliffline						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	18	18	18	18	18	18
Total	18	18	18	18	18	18
Dry-Xeric Cedar Oak						
Very High	4	4	4	4	4	4
High	2	2	2	2	2	2
Moderately High	1	1	1	1	1	1
Total	7	7	7	7	7	7
Woodland						
Very High	0	0	0	0	0	0
High	1	1	0	0	0	1
Moderately High	0	0	0	0	0	0
Total	1	1	0	0	0	1
Wooded Grassland/Shrubland						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Grass/Forb Woodland or Wooded Grassland						
Very High	29	29	0	0	0	29
High	17	17	0	0	0	17
Moderately High	28	28	29	29	29	28
Total	74	74	29	29	29	74
Canopy Gaps						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	23	23	23	23	23	23
Total	23	23	23	23	23	23

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Mature Yellow Pine and Mixed Pine-Oak						
Very High	17	17	17	17	17	17
High	15	15	15	15	15	15
Moderately High	17	17	17	17	17	17
Total	49	49	49	49	49	49
Mature Pitch Pine						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	1	1	1	1	1	1
Total	1	1	1	1	1	1
Old-aged Forests with Dead/Dying Large Trees						
Very High	0	0	0	0	0	0
High	5	0	0	0	0	5
Moderately High	1	5	5	5	5	1
Total	6	5	5	5	5	6
Early-Age Yellow Pine and Mixed Pine-Oak						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Mature/Old-Aged Beech						
Very High	1	0	0	0	0	0
High	0	1	1	1	1	1
Moderately High	0	0	0	0	0	0
Total	1	1	1	1	1	1
Mature Hemlock-White Pine						
Very High	13	13	13	13	13	13
High	5	5	5	5	5	5
Moderately High	6	6	6	6	6	6
Total	24	24	24	24	24	24
Mature High Elev. Mesic Hardwood (Pine Mtn.)						
Very High	14	14	14	14	14	14
High	1	1	1	1	1	1
Moderately High	1	1	1	1	1	1
Total	16	16	16	16	16	16
High Elevation Early-aged Forest (Pine Mtn.)						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Mature Xeric-Mesic Oak						
Very High	0	0	0	0	0	0
High	0	14	0	0	0	0
Moderately High	14	14	14	14	14	14
Total	14	28	14	14	14	14

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Mixed Mesophytic Hardwood						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	21	21	21	21	21	21
Total	21	21	21	21	21	21
Mature Forest Interior						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	10	10	10	10	10	10
Total	10	10	10	10	10	10
Mature Forest (general)						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	34	34	34	34	34	34
Total	34	34	34	34	34	34
Mature/Old-Aged Riparian Forest						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	10	10	10	10	10	10
Total	10	10	10	10	10	10
Riparian (general)						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	9	9	9	9	9	9
Total	9	9	9	9	9	9
Mid-Aged Forest						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Mixed Forest Landscape						
Very High	0	2	0	0	0	0
High	0	3	0	0	0	0
Moderately High	2	11	2	2	2	2
Total	2	16	2	2	2	2
Grassland						
Very High	32	32	32	32	32	32
High	23	23	23	23	23	23
Moderately High	27	27	27	27	27	27
Total	82	82	82	82	82	82
Early-Aged Forest						
Very High	0	8	0	0	0	0
High	0	3	0	0	0	0
Moderately High	8	9	8	8	8	8
Total	8	20	8	8	8	8

HABITAT ELEMENT		Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Fire Adapted/Enhanced							
Very High		0	3	0	0	0	0
High		3	4	0	0	0	3
Moderately High		4	5	3	3	3	4
	Total	7	12	3	3	3	7
Snags							
Very High		0	0	0	0	0	0
High		1	0	0	0	0	1
Moderately High		0	1	1	1	1	0
	Total	1	1	1	1	1	1
Open Midstory and Understory							
Very High		0	7	0	0	0	0
High		7	11	7	7	7	7
Moderately High		11	26	11	11	11	11
	Total	18	44	18	18	18	18
Dense High Shrub Understory							
Very High		0	3	0	0	0	0
High		0	2	0	0	0	0
Moderately High		3	3	3	3	3	3
	Total	3	8	3	3	3	3
Early-Aged Riparian Forest							
Very High		0	0	0	0	0	0
High		0	1	1	1	1	1
Moderately High		0	0	0	0	0	0
	Total	0	1	1	1	1	1
Downed Wood							
Very High		0	0	0	0	0	0
High		4	0	0	0	0	4
Moderately High		6	4	4	4	4	6
	Total	10	4	4	4	4	10
Den Trees							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		0	0	0	0	0	0
	Total	0	0	0	0	0	0
Hard Mast							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		0	0	0	0	0	0
	Total	0	0	0	0	0	0
Water (distance sensitive)							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		5	5	5	5	5	5
	Total	5	5	5	5	5	5

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Lakeshores, Large Reservoirs						
Very High	0	0	0	0	0	0
High	3	3	3	3	3	3
Moderately High	2	2	2	2	2	2
Total	5	5	5	5	5	5
Pond Shore						
Very High	0	0	0	0	0	0
High	4	4	4	4	4	4
Moderately High	2	2	2	2	2	2
Total	6	6	6	6	6	6
All Habitat Elements						
Very High	121	143	91	91	91	120
High	133	152	104	104	104	135
Moderately High	311	340	314	314	314	311
Total	565	635	509	509	509	566

Of key interest are habitats elements that are associated with high risk to species viability and for which management can reduce risk by improving abundance and distribution. Alternatives A, B-1, and E-1 all would reduce habitat elements associated with high-risk habitat/species relationships as a direct result of management (Table 3 - 47). These associations involve mature forests including mesic deciduous forests, riparian and upland oak forests; early-aged forests, grass/forb woodland or wooded grassland, and the structural diversity or canopy gaps found in these forests. All other alternatives are expected to maintain or increase levels of these habitat elements.

With regard to providing optimal protection and management for all habitat occurrences (primarily rare communities or naturally limited communities), Alternatives C, C-1, and D would provide for the greatest number of species with Very High, High, or Moderately High habitat/species relationship risks to viability (Table 3 - 47). This would be accomplished primarily through the combination of protection and restoration of naturally rare or limited habitats such as cliffline, caves, riparian areas, and rare communities. Management direction in all alternatives would specifically protect clifflines and caves. Riparian areas would be protected in Alternatives B-1 and E-1 and to some extent in Alternative A. Rare communities would be specifically protected in Alternatives B-1, C, C-1, D, and E-1. While protection would be provided for all of these habitats in Alternatives B-1 and E-1, management emphasis would not necessarily include restoration or enhancement of habitats. This difference accounts for the lower number of species with Very High, High, or Moderately High habitat/species relationship risks to viability provide for in this management role in Alternative B-1 and E-1.

With regard to improving habitat abundance and distribution through restoration, Alternatives C, C-1, and D would provide for the greatest number of species with Very High, High or Moderately High habitat/species relationship risks to viability (Table 3 - 47). This would be accomplished primarily through the restoration of habitats such as grass/forb woodland and wooded grassland, canopy gaps, open midstory/understory, fire-enhanced systems, and early-aged forest. Except for early-aged forest, these habitats would be limited or not included in the other alternatives. Early-aged forest would be more abundant under Alternatives A and E-1. Older forest conditions should also improve under Alternatives B-1, C, C-1, and D by a change in the cutting cycle of forests. Alternatives A and E-1 would provide the least amount of this habitat.

Alternatives C, C-1, and D should, through management action, maintain sufficient abundance and distribution of habitats associated with Very High, High, or Moderately High habitat/species relationship risks. (Table 3 - 47). On the surface this would seem to contradict what has been said above. However, close examination shows that, in fact, this means ALL species with very High, High, or Moderately High habitat/species relationship risks to viability would be supported through active management or intentional decisions to provide additional habitat where management can provide it, or to protect and enhance those habitats which are naturally limited. None would be addressed simply by trying to maintain the status quo. Active management would be expected to decrease the risk to species viability from habitat/species relationships in at least some cases. On the other hand, Alternatives A, B-1, and E-1 would manage habitats included in Very High, High, or Moderately High risk habitat/species relationship, due in part to, or largely because of, maintenance of the status quo. This management approach would not be expected to decrease the risk to species viability from habitat/species relationships.

The effect of external influences on species with Very High, High, or Moderately High habitat/species relationship risks to viability should be the same in all alternatives (Table 3 - 47) as outside influences would be expected to override management action. The habitat/species relationships most likely to be affected by external forces are associated with mature hemlock-white pine forest, mature yellow pine forest, and higher elevation forest. The hemlock woolly adelgid is expected to reach the DBNF within one or two decades. Current knowledge suggests management can do little to improve a stand of hemlock's likelihood of surviving an infestation. Limited treatments are in trial stages. Based on current knowledge, near complete loss of mature hemlock, the component of importance to most species in this evaluation, is likely over the next 50 years. A recent southern pine beetle epidemic of unprecedented intensity killed at least 70 percent of the yellow pine on the DBNF. What yellow pine did survive is scattered and largely confined to portions of the Forest where most of the associated species are not known to occur. While management efforts would be taken in all alternatives to re-establish yellow pine and yellow pine-oak forest, none of it will be mature in 50 years. Higher elevations (2,300 ft. and above) are limited on the Forest to a small ownership on Pine Mountain. The proclamation boundary includes less than one thousand acres of higher elevation lands, but much of this is in corporate or trust holdings and acquisition is unlikely.

Alternatives C, C-1 and D would not, through management action, decrease abundance and distribution of habitats associated with Very High, High, or Moderately High habitat/species relationship risks. (Table 3 - 47). Close examination shows that, in fact, this means ALL species with Very High, High or Moderately High habitat/species relationship risks to viability would be supported through active management or intentional decisions to provide additional habitat where management can provide it, or to protect and enhance those habitats which are naturally limited. The active management approach would be expected to decrease the risk to species viability from habitat/species relationships in at least some cases. On the other hand, management of some habitats with Very High, High, or Moderately High risk relationships under Alternatives A, B-1 and E-1 would reduce their abundance and/or distribution from current levels. Also, restoration of naturally rare habitat elements may not occur. Examples of these are mature forests including riparian forests in Alternative A, older forests in Alternative E-1, younger age forests in Alternative B-1, the lack of grass/forb woodland and wooded grassland in Alternative A, and the limited amounts of grass/forb woodland and wooded grassland in Alternatives B-1 and E-1. This management approach could not be expected to lessen the risk to species viability from habitat/species relationships.

Table 3 - 47. Number of species/habitat relationships rated as of Very High, High, and Moderately High risk to terrestrial species viability for each category of management effect by alternative.

Management Role	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Provide Optimal Protection and Management for All Habitat Occurrences						
Very High	0	0	15	15	15	0
High	4	5	45	45	45	5
Moderately High	22	22	78	78	78	22
Total	26	27	138	138	138	27
Improve Habitat Abundance and Distribution Through Restoration						
Very High	49	17	49	49	49	17
High	42	20	50	50	50	24
Moderately High	73	112	180	180	180	86
Total	164	149	279	279	279	127
Maintain Habitat Abundance and Distribution						
Very High	8	41	0	0	0	41
High	48	58	3	3	3	69
Moderately High	106	82	32	32	32	146
Total	162	181	35	35	35	256
Reduce Habitat Abundance and Distribution as Result of External Factors						
Very High	27	27	27	27	27	27
High	6	6	6	6	6	6
Moderately High	24	24	24	24	24	24
Total	57	57	57	57	57	57
Decline in Habitat Abundance and Distribution as Result of Management						
Very High	37	58	0	0	0	35
High	33	63	0	0	0	31
Moderately High	86	100	0	0	0	33
Total	156	221	0	0	0	99
Total for All Management Role Categories						
Very High	119	141	89	89	89	119
High	103	121	80	80	80	103
Moderately High	313	341	313	313	313	314
Total	535	603	482	482	482	536

Planning for, and evaluation of, species viability for the 2004 Forest Plan focused primarily on providing desired abundance and distribution of habitat elements to comply with NFMA regulations. Risks to species viability also can be greatly reduced by implementing other relevant law and policy. The biological assessments and evaluations conducted as part of all national forest management decisions include specific consideration of effects to federally listed threatened and endangered species, those proposed for such listing, and the Regional Forester's Sensitive Species list. These assessments and evaluations identify where additional protective measures are warranted to provide for continued existence of the species on National Forest System land. Projects that may affect federally listed or proposed species must be coordinated with the U.S. Fish and Wildlife Service. Also, these species are often the focus of inventory and monitoring efforts conducted in support of these requirements. Additional species-based provisions included in all Forest Plan alternatives supplement existing law and policy. All alternatives include general- and species-specific provisions for federally listed species, developed in coordination with the U.S. Fish and Wildlife Service

Even with management activities and direction designed to reduce risk to federally listed species in every alternative, some Very High, High, or Moderately High risk habitat relationships will remain for some listed species. The one relationship in the Very High risk category, the grass/forb wooded grassland/Virginia spiraea relationship is somewhat misleading. The habitat condition in which Virginia spiraea does best is similar to the grass/forb wooded grassland habitat, hence the coding as such in one variable. However, the species is found on rock and cobble bars along rivers and is, in fact, a riverine species. The actual creation of wooded grassland will not affect the management of or viability of Virginia spiraea unless it is created on rock bars. In this sense, Alternatives A, B-1, and E-1 do little for the species by predicted acreage of wooded grassland, but management in the three alternatives does not necessarily rule out treatment of vegetation at Virginia spiraea sites.

Four habitat/species relationships would fall into the High risk category in at least some alternatives. They include: 1) grassland/Virginia big-eared bat, 2) wooded grassland-woodland/Virginia big-eared bat, 3) caves/gray bat, and 4) lake-large reservoir-pond shore/bald eagle. Little or no wooded grassland or woodland would be created in Alternatives A, B-1, and E-1, putting the grassland/Virginia big-eared bat relationship in the High risk category. Virginia big-eared bats have been documented foraging in similar habitat, and it is believed such habitat would benefit them. This, in combination with an F2 status, leads to a habitat/species relationship in the High category. The other three relationships would fall into the High risk categories regardless of alternative. Management cannot be expected to expand naturally occurring landscape features such as caves. Hibernation habitat for gray bats – caves – remains at historical levels and is unlikely to be supplemented by management action. The species is an F1 even with current habitat, so the species/habitat association risk is likely to remain High under any alternative. However, every alternative would offer cliff and cave protection. Regardless of alternative, more bald eagle habitat would exist than at any time before European settlement. Even so, the bald eagle as a breeding species is only an F1 on the DBNF, and the habitat/species relationship risk level involving available pooled water remains High. The grassland/Virginian big-eared bat habitat/species relationship would be at the High level in all alternatives. Grassland is another habitat the species has been observed using for foraging habitat. The species' F2 status, plus low levels of grassland in all alternatives would keep this relationship in the High category.

Moderately High habitat/species risk relationships would occur for five listed species in each of the six alternatives. The natural limitations of caves and or rockshelters and the F2 status of white-haired goldenrod and Virginia big-eared bat put these relationships in this risk category. The natural limitations of mature riparian forest and the F1 status of bald eagle and gray bat put these relationships in this risk category. Additionally, these species have a relationship with general mature forest and forest interior. Since all alternatives would have a Moderately High risk for these relationships, the F1 status of the bald eagle and gray bat, not the amount of mature forest, would drive the risk. The riverbank/Virginia spiraea relationship falls into a Moderately High level. The natural limitations of riverbank habitat and the F1 status of the species lead to this risk level. Virginia spiraea also has a relationship with grass/forb wooded grassland-woodland, as explained above, that ranks in the Very High risk category. Because grass/forb wooded grassland-woodland would be more plentiful under Alternatives C, C-1, and D, the risk level for these alternatives drops to Moderately High. The grass/forb wooded grassland-woodland/Indiana bat relationship is based on observations and research showing that Indiana bats will forage at forest edge and in open stands – primarily the woodland portion of the habitat element. For this habitat/species relationship, the Moderately High risk category would apply only to Alternatives A, B-1, and E-1. For Regional Forester's sensitive species on the DBNF, Very High, High, and Moderately risk habitat/species relationships would remain under every alternative (Table 3 - 48). The greatest number would occur under Alternative B-1 and the least under Alternatives C, C-1, and D. The Very High risk levels in all alternatives are associated with the dry cedar-oak woodland/Canby's mountain lover, grassland /Fraser's loosestrife, mature yellow pine and mixed pine-oak/sweet pinesap, and the grassland and mature high-elevation mesic hardwood/Agoyan cataract moss relationships. Dry cedar-oak woodland is naturally limited on the landscape to limestone cliff and outcrop areas, although management action can improve the quality of the woodland. Since habitat is limited and Canby's mountain lover is an F1 on the DBNF, this habitat/species relationship risk would remain Very High under all alternatives. Grasslands would be limited under all alternatives, especially so under Alternatives B-1 and E-1. Grasslands are not typical of the vegetation on the Cumberland Plateau, although historically they existed on the landscape. Since the habitat is limited and both Fraser's loosestrife and Agoyan cataract moss are F1 species on the DBNF, these habitat/species relationship risks would remain Very High under all alternatives. The creation of grassy and grassy woodland or wooded grassland would reduce this risk some under Alternatives C, C-1, and D. The DBNF proclamation boundary includes very little high-elevation forest which together with the F1 status of Agoyan cataract moss result in a Very High habitat/species risk relationship under all alternatives. The loss of large acreage of mature forest with a pine component together with the slow nature of replacing this mature component and the F1 status of sweet pinesap would result in a Very High habitat/species risk relationship in all alternatives.

High risk habitat relationships for Regional Forester sensitive species are associated with bogs, springs and seeps; caves; wetlands; dry cedar-oak woodlands; grasslands; xeric-mesic oak forest; mature yellow pine and mixed yellow pine-oak forest; and grass/forb wooded grassland-woodland. Bogs, springs, and seeps; caves, wetlands, and dry cedar-oak woodlands are naturally limited on the landscape. The habitat/species relationship risks associated with these habitats, occurring in all alternatives, affect Closter's brook hypnum, Agoyan cataract moss, white-fringeless orchid, French's shooting star, small spreading pogonia, mountain thaspium, and southeastern bat. All of these species have a rank of either F1 or F2 indicating that inherent rarity of the species also contributes to the risk level. Mature yellow pine and mixed yellow pine-oak forest, while somewhat controlled by management action, is currently limited on the landscape due the southern pine beetle epidemic. The species associated with this habitat, small spreading pogonia, is an F2, indicating a relatively limited population. The High risk relationship would occur in all alternatives. This species is also part of a High risk relationship in all alternatives involving grasslands. Grasslands by management design are limited in all alternatives as they are not typical of the vegetation on the Cumberland Plateau, although historically they existed in small amounts on the landscape. Limited occurrence and the species' F2 rank lead to a relationship risk in the High category. Xeric-mesic oak forest (includes all oak forest from xeric to mesic conditions) and grass/forb wooded grassland-woodland are somewhat controlled by management action. Three species associated with oak forests include southern heartleaf, sweet pinesap, and mountain catchfly. Each has an F1 rank, and with reduced acreage of habitat in Alternative B-1, the combination would lead to a High risk rating. The last species, mountain thaspium, is also associated with the grass/forb wooded grassland/woodland habitat in the High habitat/species relationship category. This High risk would occur only in Alternatives A, B-1, and E-1 where restoration of this habitat does not occur or is limited. Moderate risk habitat relationships are associated with bogs, springs, and seeps; clifflines; grass/forb woodland and wooded grassland; grassland; mature forest (general); mature/old-aged riparian forest; mixed mesophytic forest; riparian habitat (general); early-aged forest; caves; mature yellow pine and mixed yellow pine-oak forest; mature xeric-mesic oak forest; mixed forest landscape; open midstory; and river channels. Bogs, springs, and seeps; clifflines; mixed mesophytic forest; riparian habitat (general); caves; river channels; and, to some extent, mature old/aged riparian forests are all limited by natural conditions on the landscape. Management is unlikely to create any more of the basic habitats on the ground. Species associated with bogs, springs and seeps (small spreading pogonia); clifflines (three liverworts, Canby's mountain lover, and magnolia vine); mixed mesophytic forest (mountain heartleaf and magnolia vine); riparian habitat (general)(southeastern bat, one liverwort); mature riparian forest (southeastern bat); caves (or rockshelters-cliff caddisfly); and river channels (Rockcastle aster, yellow false foxglove, Closter' water hypnum), are all F1 or F2 species on the DBNF. The combination of species rarity and naturally limited habitat – i.e. it occurs where it was likely to have occurred in the past and additional areas of these habitats are unlikely – leads to Moderately High risk for these habitat/species relationships. Management can to some extent influence the age of riparian forests, but the underlying potential for occurrence of this forest community is still naturally limited. For the species associated with this habitat, southeastern bat, an F1, the habitat/species relationship risk comes as much or more so from the rarity of the species rather than habitat rarity.

Canopy gaps are a natural feature in forest land, but management action can influence the amount and distribution. Grass/forb woodland and wooded grassland, grassland, early-aged forest, mature xeric-mesic oak forest, open midstory, mixed forest landscape, and mature forest (general) are controlled in large part by management action. Grasslands would be limited under all alternatives, especially so under Alternatives B-1 and E-1. Grasslands are not typical of the vegetation on the Cumberland Plateau, although historically they existed in small amounts on the landscape. Since the habitat is limited and the species in this habitat/species relationship risk category, the associated Diana fritillary is an F3 on the DBNF, a Moderately High risk to viability from the habitat/species association can be expected under all alternatives. Grass/forb woodland and wooded grassland would be limited under Alternatives B-1 and E-1 and not managed under Alternative A. Two of the species associated with this habitat – Rafinesque's big-eared bat and Diana fritillary – are F3s on the DBNF. Combined with the rarity of the habitat under these alternatives, a Moderately High level of risk to viability from the habitat/species relationship is likely to occur. The relatively higher levels of this habitat provided under Alternatives C, C-1 and D should maintain the risk below the Moderately High level. Because of their greater rarity, the viability risk their habitat/species relationships for Fraser's loosestrife and Canby's mountain-lover, both F1s, would be Moderately High in Alternatives C, C-1, and D (as opposed to a Very High risk rating in alternatives A, B-1, and E-1; see above). The habitat/species relationships between canopy gaps and associated species, Rockcastle aster, Canby's mountain-lover, and magnolia vine, result in a Moderately High risk to viability in all alternatives. The inherent status of all of the species (all F1) is responsible for most of this relationship risk. The habitat/species relationships between canopy gaps and associated species, southeastern bat and a liverwort, both of which are F1, results in a Moderately High risk relationship, primarily as a result of species rarity. Two habitat species relationships are associated with early-aged forest, one with Diana fritillary, and one with Rockcastle aster. Only in Alternative B-1, in which the least amount of early-aged forest is created, would the relationship climb to the Moderately High level. This habitat/species relationship would not be ranked in the Very High, High, or Moderately High categories under the other alternatives. The Moderately High risk level occurs for all alternatives for Rockcastle aster. In this case, the aster's rarity (F1) leads to this risk level. The species is actually a rock bar/cobble bar species, but needs an open canopy or canopy gaps within in that habitat. Creation of upland gaps would have no effect on the species, however.

The habitat/species relationships between mature forest (general) and the associated glossy supercoil, sweet pinesap, mountain catchfly, Fraser's loosestrife, and magnolia vine result in Moderately High risk to viability of these species in all alternatives. Even under Alternative B-1, in which little of the DBNF would be managed for a condition other than mature forest, the risk would be Moderately High. The risk level would not decrease under Alternatives A and E-1 in which the amount of mature forest would decrease by between 30,000 and 40,000 acres at any one time over B-1. In both cases, this is because all five species have high levels of rarity on the DBNF (F1 for all). Mature yellow pine and yellow pine-oak forest/Diana fritillary form a relationship with a Moderately High risk rating. The lack of mature yellow on the Forest and the species' F3 status contribute to this risk level. Mature xeric-mesic oak forest forms habitat/species relationships with sweet pinesap, mountain heartleaf, and mountain catchfly resulting in the Moderately High risk level for all alternatives. All three species are F1s and this factor is primarily responsible for the risk rating. For Alternative B-1, mature xeric-mesic oak is in a Moderately High relationship risk level in association with small spreading pogonia and hairy skullcap, both F2s. This risk level occurs in Alternative B-1 because of an increased likelihood of oak forests becoming dominated by non-oak mesic species over time. For Alternative B-1, mixed forest landscape (ages, structure, composition differences) is associated with Rafineque's big-eared bat and Diana fritillary at the Moderately High risk level. Both species are F3, but Alternative B-1 has the least diverse landscape overtime of all the alternatives. This factor contributes primarily to the risk rating.

Alternatives differ in the number of species for which there would be Very High, High or Moderately High risk habitat/species relationships (Table 3 - 48). The numerous rare – but not federally listed or on the Regional Forester's sensitive list – species, associated with Very High habitat/species relationship risks are either F1s or F?s that are treated as F1s. These species are very rare on the DBNF, and this contributes to the habitat/species relationship risk regardless of habitat conditions. For some habitat species relationships, the low amounts of habitat projected 50 years out would contribute further to the risk. In some cases this is the result of inherently limited habitats such as dry-xeric cedar-oak forest or wetlands. In other cases this is because external influences are expected to modify and reduce available habitat over the next 50 years, as is the case with mature hemlock-white pine forest and the expected effects of a hemlock woolly adelgid infestation. Some cases result from differences in management action levels, e.g., the limited amounts of young-aged forest in Alternative B-1; the small amount of open midstory/understory in Alternative B-1; the absence or limited amounts of grass/forb woodland and wooded grassland in Alternatives A, B-1, and E-1; and the limited amounts of grassland in all alternatives.

The numerous rare – but not federally listed or on the Regional Forester's sensitive list – species, associated with High habitat/species relationship risks are either F1s, F? that are treated as F1s, or F2s. These species are rare to very rare on the DBNF, and their rarity contributes to the habitat/species relationship risk regardless of habitat conditions. For some habitat species relationships, the low amounts of habitat projected 50 years out contribute further to the risk. In some cases, this is because of inherently limited habitats such as bogs or seeps, canebrakes, dry-xeric cedar-oak forest or wetlands. In another case, external influences are expected to modify and reduce available habitat over the next 50 years, as is the case with mature hemlock-white pine forest and the expected effects of a hemlock woolly adelgid infestation. Some cases are the result of differences in management action levels among alternatives, for example, the limited amounts of young-aged riparian forest provided for under Alternatives B-1, C, C-1, D, and E-1; the small amount of open midstory/understory in Alternative B-1; the absence or limited amounts of grass/forb woodland and wooded grassland in Alternatives A, B-1, and E-1; and the limited amounts of grassland in all alternatives. Habitat/species relationships involving pond margins are in yet another category. Ponds are more numerous and better distributed across the landscape currently than was the case historically. However, the species associated with them are F1s and their rarity triggers the High level of risk associated with these habitat/relationships.

The numerous rare – but not federally listed or on the Regional Forester's sensitive list – species, associated with Moderately High habitat/species relationship risks are either F1s, F? that are treated as F1s, F2s, or F3s. These species are very rare to somewhat rare on the DBNF, and their rarity contributes to the habitat/species relationship risk regardless of habitat conditions. For some habitat species relationships, the low amounts of habitat projected 50 years out contribute further to the risk. In some cases this is the result of inherently limited habitats such as bogs or seeps, caves, cliffline, dry-xeric cedar-oak forest, mixed mesophytic forest, riparian habitat, river channels, or wetlands. In another case this is because external influences are expected to modify and reduce available habitat over the next 50 years, as is the case with mature hemlock-white pine forest and the expected effects of a hemlock woolly adelgid infestation. Some cases are the result of differences in management action levels among alternatives, for example, the limited amounts of young-aged forest provided for in Alternatives B-1, C, C-1, D, and E-1; the small amount of open midstory/understory in Alternative B-1; the absence or limited amounts of grass/forb woodland and wooded grassland in Alternatives A, B-1, and E-1; and the limited amounts of grassland in all alternatives. Management can, to some extent, influence the age of riparian and beech forests, but the underlying potential for occurrence of these forest communities is naturally limited. Habitat/species relationships involving pond margins, mature forests, mature forest interior, and canopy gaps are in yet another category. Ponds are more numerous and better distributed across the landscape currently than was the case historically. However, the species associated with them are F1s. That factor and their rarity trigger the High level of risk associated with these habitat/relationships. Alternatives differ in the amount of mature forest, mature forest interior, and canopy gaps they would provide. The species associated with these habitats are either F1s or F?s that are treated as F1s. Such very rare occurrences override differences in the availability of these habitats. For other habitat elements, a difference among alternatives sometimes reduces the risk of the habitat/species relationship imposed on species viability. For some species, however, their inherent rarity overrides any abundance of habitat. This is the case with downed wood and dense high shrub understory.

Overall, Alternatives C, C-1, and D would provide for more habitat/species relationships with fewer Very High, High or Moderately High risks than the other alternatives. Alternative B-1 would carry with it the most Very High, High or Moderately High habitat/species relationship risks, primarily as the result of limited young-aged forest habitat provided for in the alternative.

Table 3 - 48. Number of terrestrial species with Very High, High, and Moderately High risk habitat relationships within each category of species status by alternative.

SPECIES STATUS	Alt.-A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Federally Listed, or Proposed, as Threatened or Endangered	6	6	5	5	5	6
Regional Forester's Sensitive Species	23	24	22	22	22	23
Other Species of Viability Concern	191	200	182	182	182	191
Total for All Species Status Categories	220	230	209	209	209	220

In conclusion, differences in effects to viability risk between alternatives would be relatively small. Current High risk species/habitat relationships result primarily from historical influences that have reduced distribution and abundance of some habitat elements and species populations. External forest health threats are likely to have the greatest future impacts. In general, the effects of proposed management strategies would be small compared to historical impacts and future external threats. Risks to species viability would be minimized by alternatives that provide a balanced mix of low-disturbance and disturbance-dependent habitat elements. Some elements in this mix would be best provided through passive management and protection. Others may require active management for restoration and maintenance.

Efforts to refine information on current abundance of species on the DBNF will continue, and results of these efforts will be reflected in various documents over the life of the 2004 Forest Plan. The refinement of this input data could change risk ratings for individual species; however, overall patterns of risk relative to habitats and management effects are not expected to change substantially.

AQUATIC SPECIES VIABILITY

Affected Environment

The landscape of eastern Kentucky has changed dramatically since the late 1800s, when the dominant use was small-scale subsistence farming. Logging and land clearing for agriculture accelerated in the early 1900s, and by 1930 most of eastern Kentucky had been cleared. From the 1920s to the 1970s, mining companies stripped and deep-mined coal on adjacent private lands both inside and outside of the proclamation boundary. Mining resulted in the loss of valuable topsoil, high rates of stream sedimentation, and degradation of aquatic habitats and faunal communities. These early impacts to the land that would become the DBNF helped shape the current landscape and conditions of the streams and aquatic systems.

Coal mining has degraded over 40 miles of stream on DBNF system lands. Oil drilling has degraded another 20 miles. Sedimentation and runoff of agricultural chemicals as well as animal wastes from farm lands, discharge from domestic wastewater systems, and sedimentation from roads and timber harvest are also water quality issues facing DBNF managers today.

An increase in the amount of off-highway-vehicle (OHV) and horse riding use, on and off the DBNF, has increased stream sediment loads and adversely affected aquatic biota. The special problems generated by OHVs are addressed in a separate Environmental Impact Statement (USDA Forest Service 1998).

Since implementation of the DBNF's 1985 Plan, Forest managers have improved 2,180 watershed acres, upgrading hydrologic function, soil productivity, and water quality.

For this analysis, short-term refers to activities or conditions that occur within the expected life of the 2004 Forest Plan (10 years). Long-term refers to activities or conditions that occur beyond the expected life of the Plan.

VIABILITY EVALUATION

National forests are required to manage aquatic habitats for the maintenance of viable populations of existing native and desired non-native plants, fish, and wildlife species in the planning area. The National Forest Management Act (NFMA) defines a viable species population as "the estimated numbers and distribution of reproductive individuals to insure its continued existence [and] is well distributed in the planning area so that those individuals can interact" (36 CFR 219.19).

Aquatic habitats are those in and adjacent to streams and lakes. The mobility of aquatic species is usually limited to these habitats. Habitat alteration is likely the major cause of decline of aquatic diversity in the South. Channelization, impoundment, sedimentation, and flow alterations are the most common physical habitat alterations associated with the decline of aquatic species (Walsh et al. 1995; Etnier 1997; Burkhead et al. 1997). Other human-induced impacts to aquatic species include pollution and introduced species (Miller 1989).

Habitat quality within a freshwater ecosystem is determined by activities within the watershed (Abell et al. 2000; Scott and Helfman 2002). Effects of proposed activities on suitable aquatic habitat in a watershed can be estimated from watersheds having similar characteristics. At the Forest Plan level, the watersheds considered for aquatic species are 5th level hydrologic units.

To determine if adequate habitat conditions exist for PETS (Proposed, Endangered, Threatened and Sensitive) species, 5th level watershed condition was assessed including both impacts occurring on private as well as on public lands. Watersheds assessed were those with any National Forest ownership. Watershed condition was determined from the physical and anthropogenic interactions within the watershed. The extent and detail required to address all watersheds, including private land, made it necessary to determine values from geographic data. After these values were compared among the watersheds, a condition or set of conditions was determined.

METHODS AND ASSUMPTIONS FOR WATERSHED CONDITION

Watersheds or hydrologic units are defined as areas that drain to a common point. Fifth level watersheds are generally between 40,000 and 250,000 acres. Geographic information (GIS) layers were queried by watershed. These layers include ownership, streams, roads, point sources, dams, and land-use from the 1970s and 1990s.

These layers were intersected with the 5th level watersheds and determined as a percent of the watershed or as a density (miles per square mile). Table 3 - 49 identifies the layers, their use, data source, and unit of measure.

Table 3 - 49. Geographic layers used to determine watershed condition.

Layers	Use	Source	Unit
Watersheds	Planning unit	NRCS or USFS	5th level HU
Ownership	To determine the potential of affect of NF ownership on viability of Species of Concern	Individual Forests	Percent
Streams	Used to determine riparian areas	RF3 data from EPA Basins III	Not applicable
Roads	Road density and riparian road density	TIGER census data	Miles per square mile
Landuse	Determine watershed and riparian area landuse	1970 GIRAS data from EPA Basins III, 1994 NLCD from EPA Region 4	Percent
Dams	Determine altered flow	EPA Basins III	Number per square mile
Point sources	CERLIS, RICRIS and NPDES	EPA Basins III	Number per square mile

This process is modified from the East-wide Assessment Protocol for Forest Plan Amendment, Revision, and Implementation (USDA Forest Service 2000). Instead of a simplified ranking, the individual condition factors were valued or graded (one to five) based on natural breaks using the Jenk’s optimization formula within ArcView 3.2a. The values for each layer were averaged to calculate a condition score for each metric where; 1 – 1.5 = Poor, 1.51 – 2.5 = below average, 2.51 – 3.50 = Average, 3.51 – 4.5 = Above Average, 4.51 – 5 = Excellent. This allows for a determination of condition among the watersheds. However, it does not suggest that the condition of a watershed with a score of 4 is twice as good as a watershed of 2, only that the condition of a watershed with a value of 4 is above average and the watershed with a value of 2 is below average. These metrics were developed to determine watershed condition for individual issues or concerns.

A species-sediment load relationship index (SSI) was developed to characterize the condition (Excellent, Average, and Below Average) of 5th level watersheds with respect to current sediment load increases and to determine a range of potential effects. These metrics were used to determine watershed condition for particular stressors listed below:

1) Sedimentation, assessed separately by determining the percent increase above the baseline sediment levels by watershed as assessed with the Watershed Condition Rank (WCR)
2) Point Source Pollutants (density of point sources)
3) Temperature (road density in the riparian area, and percent forest in the riparian area) (1970s and 1990s data)
4) Altered stream flow (density of dams, road density in the riparian area and average density of strip-mines).

Stressors

PETS species were noted for each 5th level watershed in which they occurred across the Forest. The PETS species referenced are those identified by the US Fish and Wildlife Service as potentially occurring on or adjacent to the Daniel Boone National Forest. Watershed condition was assessed with the occurrence of aquatic PETS species and their associated stressors within this 5th level. This 5th level watershed analysis is to examine the coarse filter of watershed condition from impacts on private and public lands. This coarse filter at the 5th level will allow the Forest Service to examine conditions throughout the entire watershed in order to understand the status of aquatic PETS species.

Four stressors were identified: sedimentation, point-source pollution, alterations in water temperature, and altered stream flows. Sensitivity to these stressors was assigned for each species, based on the published literature and personal communications (Terwilliger 1991; Etnier and Starnes 1993; Byron Freeman, Wendell Haag, Melvin Warren, Bernard Kuhajda, Stephen Hiner, and Arnold Eversole, personal communication). Species sensitivity to the four stressors was compared with the condition of their respective watersheds to determine the threats to their persistence in the planning area. Threats to aquatic species viability are not limited to these four variables. The variables chosen were selected based on the consistency of Geographic Interface System information across both private and public lands, but do not reflect all impacts to the viability of aquatic biota. In addition, the thresholds of PETS species to these four stressors are not known. Loss of viability would result in extirpation or possibly extinction. There have been no known extirpations of any PETS aquatic species from the DBNF.

Forest level planning assumes that these four stressors describe any potential land disturbance activities within the planning area. The Forest Service seeks to maintain or enhance waters within public ownership. Habitat on National Forest System lands will be maintained or enhanced. These waters also could provide refuge for some imperiled species.

Combination of Watershed Condition and Stressors

To identify watersheds at risk, the combined values for each watershed condition value or parameter (sediment, point sources, temperature and altered flows) were multiplied against the presence (value of 1) of species of concern with corresponding stressors. Watershed condition metrics with a score $\geq$ 2.51 (average or above for point sources, temperature and altered flows) and an SSI of Excellent (for sediment) are assumed to have sufficient aquatic habitat at the watershed scale to maintain species viability.

Aquatic Viability Outcomes

Species of concern were related to the four environmental factors assessed in the watershed analysis (point sources, water temperature, flow, and sediment). Separate viability outcomes were determined for each watershed where a species occurs because factors affecting viability can vary considerably from one watershed to another. Viability outcomes for each species by watershed were determined by incorporating elements of species distribution, abundance, and sensitivities to environmental factors; watershed condition relative to the species' environmental sensitivities; and the amount of National Forest ownership in the watershed. Viability outcomes are as follows:

> **Outcome A:** Species occurs within watersheds with no impairment. Likelihood of maintaining viability is High.
>
> **Outcome B:** Species is potentially at risk in the watershed; however, Forest Service action may influence habitat conditions on public lands that will keep it well distributed where its associated habitat occurs on National Forest System lands. Therefore, likelihood of maintaining viability is Moderate.
>
> **Outcome C:** Species is potentially at risk within the watershed; however, opportunities for the Forest Service to affect outcomes for the species in the watershed are limited. PETS species within this outcome are off National Forest System lands. Therefore, species viability in the watershed may be at risk.
>
> **Outcome D:** The species is so rare within the watershed (population is at Very Low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service actions could influence conditions in the watershed to keep the species relatively secure. Therefore, likelihood of maintaining viability is Moderate to Low.
>
> **Outcome E:** The species is so rare within the watershed (population is at Very Low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service ability to influence the species is limited. Therefore, species viability in the watershed may be at risk.

For a summary of aquatic PETS species on the DBNF by number of watersheds and viability outcome, see Table 3 - 50. No outcomes should change as a result of impacts from any of the alternatives. The "Total Watersheds" column lists the number of watersheds in which each PETS species occurs. The species listed in the following table are those that were identified by the US Fish and Wildlife Service as potentially occurring on or adjacent to the Daniel Boone National Forest.

Table 3 - 50. Summary of PETS and non-PETS by number of watersheds and viability.

Species	Number of watersheds by Viability Outcome					Total Watersheds
	A	B	C	D	E	
American Brook lamprey	3		1			4
Ashy darter	4		4			8
Big South Fork crayfish	1		1			2
Blackside Dace	8		2			10
Blotchside logperch			1			1
Cumberland Bean	4		5			9
Cumberland elktoe	3					3
Cumberland Johnny darter	7		2			9
Cumberland papershell	1					1
Cumberlandian Combshell	3		1			4
Duskytail Darter	1		1			2
Eastern sand darter	6		3			9
Fanshell						
Fluted Kidneyshell	4		2			6
Little Spectaclecase	5		4			9
Littlewing Pearlymussel	2		4			6
Longhead darter	1		1			2
Long-solid	2					2
Mountain Brook lamprey	1		1			2
Northern madtom	1		1			2
Olive darter	3		1			4
Oyster Mussel	3		1			4
Palezone Shiner			2			2
Pink mucket						
Purple lilliput	2		2			4
Pyramid pigtoe	1					1
Rabbitsfoot						
Salamander mussel	1		1			2
Sheepnose	1					1
Snuffbox	3		4			7
Southern cavefish	1					1
Spectaclecase						
Spotted darter			1			1
Tan Riffleshell	1					1
Tennessee clubshell	3		4			7
Tippecanoe darter	1		2			3
Western sand darter						
Non PETS Species	4		1			5

PETS species with an Outcome of A are considered at low or no risk to their viability. Species with an Outcome of C are subject to impacts from one or more of the stressors. These species are off National Forest System lands, and the Forest Service may not be able to do anything to measurably improve their habitat conditions. Due to the coarseness of the model no species have viability Outcomes in B, D, or E.

Any degradation of aquatic habitat can adversely affect aquatic management indicator species (MIS). The effects on species more tolerant to sediment and other forms of pollution would be similar for all alternatives. The differences will be more apparent in species that are sensitive to pollution or have very low populations. The next section describes the MIS and how each alternative would affect them.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

None other than those listed under the alternatives.

CUMULATIVE EFFECTS

Best Management Practices (BMPs), the Riparian Corridor Prescription Area, and Forest Plan Standards should minimize direct and indirect adverse effects to aquatic communities. Adverse effects, however, will not be eliminated from the entire watershed. Cumulatively, Forest Service activities may contribute to sediment in the watershed.

Watershed Condition Rank (WCR) is a measure that characterizes the condition of 5th level watersheds with respect to current and future sediment load increases. In order to establish WCRs, the current sediment average annual yield is determined and expressed as a percent above the baseline conditions. This provides a relative measure to determine changes within watersheds. The next step in this process is determined by using the relative abundance of locally adapted species with respect to predicted sediment increases to create a species-sediment load relationship or index (SSI). This score is modified by a weighted average where the watershed occurs in more than one physiographic zone. Watershed condition is generalized into three categories of Excellent, Average and Below Average. The SSI, however, does not necessarily translate into an excellent or poor watershed but broadly categorizes the watersheds based on the sediment prediction/aquatic viability relationship. The SSI is a relatively large-scale coarse filter developed to evaluate alternatives in Forest Plans and to establish priority work at the planning scale. Therefore, further detailed analyses of the watershed will be conducted at the project level.

Table 3 - 51 summarizes the cumulative watershed condition for all alternatives within period one (the first decade). A brief description of the process and the current conditions are described in the Soil and Water section of this document. A full description of the process can be found in the process record for this Final Environmental Impact Statement.

Ownership is the percentage of the watershed managed by the Forest Service. SSI is the species-sediment load relationship or index score. Risk 1 indicates watershed concerns but management actions may influence conditions to improve the condition of the watershed that may reduce the risk to aquatic species. Risk 2 also indicates watershed concerns; however, Forest Service opportunities to measurably affect the watershed are limited. Sources of impairment: S = sediment; P = point-source pollution; T = temperature; F = Altered Flow.

Table 3 - 51. Summary of 1st decade cumulative effects on watershed conditions by alternative.

	Ownership	Current	Watershed Condition			Alt-A	Alt-B1	Alt-C	Alt-C1	Alt-D	Alt-E1
Watershed	%	SSI	Low Risk	Risk 1	Risk 2	SSI	SSI	SSI	SSI	SSI	SSI
5100101040	57.3	E	X			E	E	E	E	E	E
5100101090	11.3	E			S	E	E	E	E	E	E
5100101100	31.8	E	X			E	E	E	E	E	E
5100101110	37.4	E	X			E	E	E	E	E	E
5100101130	29.8	E	X			E	E	E	E	E	E
5100101140	28.4	E	X			E	E	E	E	E	E
5100202010	8.4	E			S	E	E	E	E	E	E
5100202020	0.2	E			S	E	E	E	E	E	E
5100202030	18.5	E	X			E	E	E	E	E	E
5100203010	60.8	E	X			E	E	E	E	E	E
5100203020	17.4	E			S	E	E	E	E	E	E
5100203040	14.2	E			S	E	E	E	E	E	E
5100203050	8.4	E			S	E	E	E	E	E	E
5100204010	2.9	E			S	E	E	E	E	E	E
5100204020	8.7	E			S	E	E	E	E	E	E
5100204030	9.7	E			S	E	E	E	E	E	E
5100204040	9.0				S	E	E	E	E	E	E
5100204050	27.0	E	X			E	E	E	E	E	E
5100204060	11.3	E			ST	E	E	E	E	E	E
5100204070	2.4	E			ST	E	E	E	E	E	E
5100204120	50.2	E	X			E	E	E	E	E	E
5100204140	20.5	E	X			E	E	E	E	E	E
5100204170	8.5	E			ST	E	E	E	E	E	E
5130101350	4.7	E			S	E	E	E	E	E	E
5130101360	17.1	E			S	E	E	E	E	E	E
5130101370	57.6	E	X			E	E	E	E	E	E
5130101400	19.5	E	X			E	E	E	E	E	E
5130101410	29.7	E	X			E	E	E	E	E	E
5130101420	62.3	E	X			E	E	E	E	E	E
5130101440	54.3	E			S	E	E	E	E	E	E
5130101450	38.9	A			S	A	A	A	A	A	A
5130102030	44.5	E	X			E	E	E	E	E	E
5130102040	10.2	E			S	E	E	E	E	E	E
5130102050	38.7	E	X			E	E	E	E	E	E
5130102060	6.8	A			S	A	A	A	A	A	A
5130102070	46.7	E	X			E	E	E	E	E	E
5130102080	3.9	E			S	E	E	E	E	E	E
5130102090	34.5	A			S	A	A	A	A	A	A
5130102100	89.6	E	X			E	E	E	E	E	E
5130103010	60.7	E	X			E	E	E	E	E	E
5130103020	95.1	E	X			E	E	E	E	E	E
5130103040	9.6	E			S	E	E	E	E	E	E
5130104250	43.3	E	X			E	E	E	E	E	E
5130104270	5.5	E			S	E	E	E	E	E	E
5130104290	60.6	E	X			E	E	E	E	E	E
5130104310	5.1	E			S	E	E	E	E	E	E

The Watershed Condition rating from Table 3 - 51 indicates which source of impairment (S, P, T or F), if any, is a major stressor in that watershed, and whether or not the Forest Service can measurably influence that impairment at the watershed level. Where the impairment is sediment (S), Forest Service influence is limited based on the SSI discussion below. Where the impairment is temperature (T), the Forest Service can influence conditions at a local level by maintaining a streamside canopy. However, streamside canopy often is not sufficient to mitigate temperature increases originative from private land; therefore, the Forest Service's influence on temperature at the watershed level is limited.

The SSI is used to characterize cumulative effects of sediment from both private and National Forest System lands within a specified watershed. It takes into account biological thresholds for sediment. Possible SSI are: Excellent (E); Average (A); Below Average (BA); a Below Average SSI rating indicates that the effects from sediment are approaching a biological threshold. No DBNF watersheds merited a Below Average rating.

WCR calculations are useful in the development of forest plan objectives. The following section details WCR outcomes with respect to adverse effects on aquatic biota as they are related to forest management:

> A watershed SSI of Excellent indicates a Low probability for adverse effect to aquatic species. If the results of a forest plan alternative remain within this range there should be no adverse effect on water quality with respect to beneficial uses (fish communities). Forest plan objectives, therefore, would focus on maintaining or improving aquatic health through the implementation of management prescriptions that support riparian values.
>
> A watershed SSI of Average**,** indicates a Moderate probability for adverse effects on beneficial uses. In this case, forest plan objectives should stipulate that watershed assessments be conducted during project planning to identify pollution sources. Additionally, objectives should provide for monitoring prior to project implementation to determine actual health of the biota.
>
> A watershed SSI of Below Average, indicates a High potential for adverse effects to beneficial uses. In addition to the objectives listed above, forest management at the project level should seek to maintain or restore watershed health and aquatic systems where Forest Service actions can make meaningful contributions to watershed health. Forest plan prescriptions should be applied in an effort to correct unhealthy situations.

The sediment model and the WCR both rely on numerous assumptions. To minimize any misunderstanding, every effort has been made to acknowledge assumptions and describe them clearly. In light of these assumptions, however, neither the sediment model nor associated WCR should be regarded as absolutes. At the forest plan level, they are useful in comparing the outcomes that would likely result from the various alternatives. Regardless of assumptions or methods, the overall intention remains the reduction of risk to water quality and aquatic biota.

Watershed condition, expressed at the outfall of the watershed, reflects accumulation from disturbances across the entire watershed. Subwatersheds within a 5th level watershed will have a range of conditions. The conditions of subwatersheds and the determination of effects will occur at the project level.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Under Alternative A, the 1985 Plan and would continue to be implemented while meeting or exceeding minimum protection under the Endangered Species Act and the National Forest Management Act. The harvest/removal of resource products and some recreational activities as well as roads may increase sedimentation with short-term localized adverse affects on aquatic ecological processes. This analysis takes into account that approximately 85 percent of the DBNF is available for leasing of federal minerals. Sedimentation and habitat fragmentation are the main contributors to the degradation of aquatic communities. The impacts from sedimentation would be localized to areas immediately adjacent and downstream from the disturbance site. These short-term effects, however, can lead to long-term adverse effects on aquatic species, e.g., sedimentation deposits on a mussel bed.

Forestwide protective measures under this alternative have been applied to perennial and intermittent streams. Such measures include watercourse protection strips, filter strips, and shade strips. However, there is a concern that the application of these measures may not provide adequate protection to maintain viability of several aquatic species (USDA Forest Service 2001). This will have both long- and short-term adverse effects. Without specific management to support the health and viability of aquatic organisms, those in decline may continue in that direction and those with static populations may remain so or could begin to decline. Fragmentation, habitat, and ownership, would continue to be a problem and habitat fragmentation could increase with time. Fragmentation would have long- and short-term detrimental effects on the aquatic community if populations are isolated or movement is restricted. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. The continued introduction of this non-native species, in addition to the public’s impact in the pursuit of this species, will have long- and short-term adverse effects. Due to the predatory nature of this species, short-term stocking of trout may affect the long-term productivity of stocked streams by reducing genetic diversity and the number of aquatic organisms available to repopulate the stream if trout are removed. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

The viability of aquatic species would be tracked, in part, through the monitoring of management indicator species (MIS). Under the National Forest Management Act (NFMA), the Forest Service is charged with preserving and enhancing the diversity of plants and animals consistent with overall multiple-use objectives stated in the Forest Plan [16 U.S.C. 1604(g)(3)(B) – Planning Management Requirements]. To do this, MIS are selected “because their population changes are believed to indicate the effects of management activities” [36 CFR 291.19(a)(1), Planning – Fish and Wildlife Resources].

In general MIS are selected to meet one of the following criteria. They can be:

- Ecological indicators
- Species commonly hunted or of economic significance
- Threatened or endangered species.

Table 3 - 52 shows the seven fish species selected to track a variety of aquatic habitats and conditions.

Table 3 - 52. MIS and habitat and conditions being tracked.

MIS	Habitat or condition being tracked
Blackside dace	Federal threatened species; found only in a few streams.
Smallmouth bass	Demand species; clean-bottom streams and stream fed lakes.
Arrow darter	Indigenous to upper Cumberland and Kentucky River system.
Fantail darter	Prefers shallow rifles and pools with a gravelly substrate.
Rainbow darter	Occur in streams with clean gravel substrate.
Brindled madtom	Occur in creeks and rivers with very little silt.
Stoneroller	Common and widespread throughout the Forest.

These seven fish were originally selected as MIS for the 1985 Plan. The 5th Year Review Daniel Boone National Forest Lands and Resources Management Plan (USDA Forest Service 1991) and in the Daniel Boone National Forest MIS Population and Habitat Trends Report 1985 – 2000 (USDA Forest Service 2000) determined that none of the seven fish served their intended purpose as MIS. Replacement of the fish species with aquatic macro-invertebrates was recommended. Since Alternative A is the 1985 Plan, these seven fish species would represent MIS for this alternative.

Without the designation of an area specific for the health and viability of aquatic organisms, species susceptible to silt and fragmentation (arrow, fantail, and rainbow darter, and brindled madtom) or with low population numbers (blackside dace) may have stable or falling populations. Species that are less susceptible (smallmouth bass and stoneroller) would have stable populations. And there would be little opportunity for recovery of susceptible species or those with reduced populations.

To help facilitate a comparison of the alternatives, MIS developed for Alternatives B-1 through E-1 were considered for Alternative A. Indices based on aquatic macro-invertebrate assemblages that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, are to be used. Because these indices are not individual, or groups of, species, they will not be referred to as “management indicator species.” They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. Therefore, these indices will be used in lieu of MIS for aquatics.

Without the designation of an area specific to protect the health and viability of aquatic organisms, i.e., the Riparian Corridor Prescription Area, species susceptible to silt and fragmentation or with low population numbers may have stable or falling populations. Those species that are less susceptible would have stable populations. There would be little opportunity for recovery of susceptible species or those with reduced populations.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This would contribute little or no sediment to the aquatic system. There should be long-term benefits through the establishment of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Other wildland fires would be suppressed. In the short-term these wildland fires could cause an increase in sediment loads to adjacent streams.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution originate primarily off National Forest System lands and would remain beyond the control of the DBNF.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

While this alternative would be mainly custodial, it would establish a Riparian Corridor Prescription Area (RCPA). The RCPA would encompass riparian areas, as well as adjacent associated upland components. The width of the RCPA would vary but would always be measured from the edge of the channel or bank. The RCPA encompasses, at a minimum, the 100-year flood plain along perennial and intermittent streams or other water bodies. However, the width could be greater (Table 3 - 53). The width for perennial streams and other perennial water bodies would be a minimum of 100 feet from the bank or channel; and for intermittent streams, a minimum of 50 feet from the channel.

Table 3 - 53. Width of riparian corridor, measured from the edge of each bank.

TYPE OF WATER BODY	Distance from each bank, in feet (if greater than the 100-year flood plain)
Perennial streams and other perennial water bodies (excluding the Large Reservoir PA)	100
Intermittent streams	50

An interrupted stream (a watercourse that goes underground and then reappears) would be measured as if the stream were above ground. For braided streams, the outermost braid would be used as the water's edge. For ponds, small lakes, wetlands (including associated seeps or springs), and other water bodies, the measurement would begin at the ordinary high water mark.

This RCPA will provide for protection of the aquatic habitat and will help reduce habitat fragmentation. No active manipulation within the RCPA would take place except for visitor safety and to meet the Forest's legal responsibilities such as providing for the viability of plant and animal species and the protection of PETS species. Without active manipulation for the purpose of attaining and sustaining a high diversity of habitat and species, recovery of declining species could be slow or nonexistent.

The viability of aquatic species would, in part, be tracked through the monitoring of Management Indicator Species (MIS). Indices based on aquatic macro-invertebrate assemblages that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. Because these indices are not individual, or groups of, species, they will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. Therefore, these indices will be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. With the custodial emphasis of this alternative, any improvements or recoveries would be slow with most species populations remaining constant. There would be little expected change in the indices due to the lack of management directed to ecosystem improvements.

There would be continued use of the Forest at the maintenance level. New trails would be built and some existing trails would be closed with a resulting net decrease of 52 miles of trails. All trails would be closed to off-highway vehicles. Trails, roads, and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or closed. Mineral extraction or development would be limited, especially surface-disturbing activities. Soil baring disturbances and erosion would be minimal.

Timber harvest would occur minimally and recreation facilities and developed sites would only be maintained. This reduction in sediment producing activities would have short- and long-term beneficial effects on the aquatic community. Trout stocking would not be undertaken in this alternative, which would result in short and long-term beneficial effects on the aquatic community. Ownership fragmentation would decrease because of increased emphasis on the purchasing program. Inholdings and other land within the proclamation boundary would continue to be purchased. Riparian management would be minimal except for the viability needs of certain land species. Any short-term sedimentation could lead to long-term adverse effects on aquatic species, e.g., sedimentation deposits on a mussel bed.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This would contribute little or no sediment to the aquatic system. There should be long-term benefits, however, through creation of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

The short-term establishment of a RCPA would have the long-term productivity effect of providing protected habitat for the aquatic community.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution originate primarily off National Forest System lands and would remain beyond the control of the Forest.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the maintenance of ecological processes and function while providing for multiple public benefits. It would establish a Riparian Corridor Prescription Area[8] (RCPA). The RCPA would help protect aquatic habitat and reduce habitat fragmentation. The purchasing program of the Forest would decrease ownership fragmentation. Inholdings and other lands within the proclamation boundary would continue to be purchased.

Vegetation management designed to meet viability needs could result in sedimentation from soil disturbance. In the short-term this could create localized adverse impact from increased sedimentation loads to the streams. In the long-term, however, this vegetation management would benefit aquatic habitats through bank stabilization, increased habitat diversity, and the influx of coarse woody debris. Although private mineral development would be allowed in the RCPA, development of federally owned minerals would be more restricted here than in the rest of the watershed. Recreation (developed and dispersed) would remain near current levels. Trails, roads, and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or

[8] See description in Alternative B-1

closed. Aquatic systems and organisms should benefit from this alternative's emphasis on attaining and sustaining a high diversity of habitats and species. Any short-term sedimentation, however, could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

Vegetation manipulation would take place for the purpose of attaining and sustaining a high diversity of habitats and species. The RCPA would be protected from damaging activities and degraded areas would be restored. In the short- and long-term this would provide habitat to help restore of aquatic PETS species and would be very beneficial to the aquatic community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. This would have long- and short-term adverse effects through the continued stocking of this non-native species and through the public's impacts in their pursuit of this species. No new streams would be considered for stocking. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

The viability of aquatic species would be tracked, in part, through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. Therefore, these indices will be used in lieu of MIS.

There would be a positive effect on MIS from establishment of the RCPA. The emphasis on maintenance of ecological processes should be reflected in increased water quality and aquatic habitat.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This will contribute little or no sediment to the aquatic system. There should be long-term benefits from the creation of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term, wildland fires can cause increased sediment loads in adjacent streams.

The short-term establishment of a RCPA would have the long-term, productive effect of providing protected habitat for the aquatic community.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution originate primarily off National Forest System lands and would remain beyond the control of the Forest. Sites located on the Forest would be addressed to reduce or eliminate their impacts.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the maintenance of ecological processes and function while providing for multiple public benefits with added emphasis on recreation. It would establish a Riparian Corridor Prescription Area[9] (RCPA). The RCPA should provide long- and short-term benefits by reducing habitat fragmentation and protecting streamside areas. The purchasing program of the Forest should decrease ownership fragmentation. Inholdings and other land within the proclamation boundary would continue to be purchased.

Manipulation of vegetation to improve species viability, in areas adjacent to aquatic habitats, could result in sedimentation from surface and soil disturbance (e.g., prescribed fire, creation of snags, planting, control of non-native invasive species, etc.). In the short-term this may create localized adverse impacts by increasing sedimentation loads in streams. In the long-term, however, such vegetation management would benefit aquatic habitats by stabilizing banks and increasing both habitat diversity and the influx of coarse woody debris. Although mineral development would be allowed in the RCPA, development of federally owned minerals would be more restricted here than in the rest of the watershed. The added emphasis on recreation could increase localized sedimentation. An additional 73 miles of trails would be added to the trail system. Trails, roads, and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or closed. The emphasis on attaining and sustaining a high diversity of habitats and species should benefit aquatic systems and organisms. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

The viability of aquatic species would, in part, be tracked through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as 'management indicator species'. They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. The indices will therefore be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. Indices would reflect an increase in water quality and aquatic habitat due to the emphasis on maintenance of ecological processes. There may be localized detrimental impacts to some assemblages that would be reflected in the indices. This would be due to the potential increase in recreation use of both developed and dispersed sites.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This will contribute little or no sediment to the aquatic system.

[9] See description in Alternative B-1.

There should be long-term benefits through the establishment of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

Any short-term sedimentation could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution are primarily from non-National Forest System lands and would remain out of the control of the Forest under this alternative. Those sites located on the Forest would be addressed to reduce or eliminate their impacts.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize recreational opportunities to the extent possible. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA). See description in Alternative B-1. This would have long- and short-term beneficial effects through reducing habitat fragmentation and protection streamside areas. Ownership fragmentation would decrease because of the purchasing program of the Forest. Inholdings and other land within the Proclamation Boundary would continue to be purchased.

Increased recreation for this alternative would result in an increase in localized sedimentation being generated through the increase in roads, trails and facilities. There would be 113 miles of trails added to the current trail system. With this increase in sedimentation there would be short-term localized adverse effects to aquatic resources. These short-term effects, however, could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed. Although mineral development would be allowed in the RCPA, development of federally owned minerals would be more restricted here than in the rest of the watershed. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. Also, other streams would be evaluated for additional trout stocking. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

The viability of aquatic species would, in part, be tracked through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as 'management indicator species.' They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. The indices will therefore be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. There may be localized detrimental impacts to some assemblages that would be reflected in the indices. This would be due to the emphasis on recreation, which may amplify localized sedimentation from the increase in developed and dispersed sites.

Ecosystem diversity and sustainability would be, at least, maintained to meet minimum protection under the Endangered Species Act and the National Forest Management Act. This would be beneficial, but additional efforts to attain and sustain a high diversity of habitat and species would be secondary to recreational needs and funds. Due to the priority of recreation, there would be less funding available for the development of habitat diversity. There would be more recreational development within the RCPA and this could adversely affect the aquatic community.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This will contribute little or no sediment to the aquatic system. There should be long-term benefits through the establishment of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

Any short-term sedimentation could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution are primarily from non-National Forest System lands and would remain out of the control of the Forest under this alternative.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Alternative E-1 would emphasize the quality as well as the quantity of resource products to maximize benefits to local and regional communities. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA). See description in Alternative B-1. This would have long- and short-term beneficial effects through reducing habitat fragmentation and protection streamside areas. Ownership fragmentation would decrease because of the purchasing program of the Forest. Inholdings and other land within the Proclamation Boundary would continue to be purchased.

The emphasis on commodities development could increase sedimentation levels in areas adjacent to activities with both long- and short-term localized adverse affects on the aquatic community. Trout stocking would be maintained at current levels as long as viability of native species were unaffected. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public’s impacts in their pursuit of this species. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

The viability of aquatic species would be tracked, in part, through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. The indices will therefore be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. There may be localized detrimental impacts to some assemblages that would be reflected in the indices. This would be due to the emphasis on resource products, which may amplify localized sedimentation from the increase in disturbed sites.

Ecosystem diversity and sustainability would be maintained to meet minimum protection under the Endangered Species Act and the National Forest Management Act. This would be beneficial, but only at minimal levels. Additional efforts to attain and sustain a high diversity of habitat and species would be secondary to resource products needs and funds. All wildland fires would be suppressed. Fire management would be used to improve plant and wildlife habitat, reduce fuels for fire prevention, and prepare sites for planting or natural regeneration. These fires would have a short-term adverse effect through an increase in the sediment loads of nearby waterways. There would be a long-term beneficial effect through the enhancement and maintenance of biological diversity.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities but would primarily be used to reduce fuels for fire prevention, and prepare sites for planting or natural regeneration. This will contribute little or no sediment to the aquatic system. There would be long-term benefits through the establishment of a more diverse and stable streamside habitat. All wildland fires would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

Any short-term sedimentation could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution are primarily from non-National Forest System lands and would remain out of the control of the Forest under this alternative. Those sites located on the Forest would be addressed to reduce or eliminate their impacts.

RIPARIAN SPECIES VIABILITY

Affected Environment

Riparian areas are functionally defined as areas with three-dimensional ecotones of interaction that include both terrestrial and aquatic ecosystems. They extend down into the groundwater, up above the canopy, outward across the flood plain, up the near-slopes that drain into the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width (Ilhardt, et al. 2000).

Six distinct habitat types are included in the riparian area. All occur in conjunction with stream corridors. The habitats are related by proximity to a stream, and the function of ground and surface water within the habitats. Three of these habitat types are found within the stream channel itself: sand/gravel/cobble bars, boulder (scour) bars, and stream banks. The other three are found on a stream flood plain or terrace; these are eastern riverfront forest, river flood plain forest and canebrakes.

To date, there has been no systematic survey of the extent or condition of the riparian area on the DBNF. However, cooperative rare species inventories conducted between 1987 and 1993 (USDA Forest Service et al. 1988-1994) identified many locations for sand/gravel/cobble bars and boulder bars, and a few locations for river flood plain forest. Project species surveys have identified others. About 25 locations for bars with rare plants on them are known, all from the Cumberland River drainage. Another two sites are known for river flood plain forest with unusual vegetation, both from the Cumberland River drainage. Several canebrakes are recorded from the northern end of the Forest, but others exist. Eastern river front forest is present on, and dispersed across, the DBNF. Stream bank habitat is present across the Forest. The extent of all of these habitats is unknown.

Current stream miles are likely unchanged from the miles present 200-300 years ago. The condition of the streams and associated habitats probably has changed. Land clearing over the last 200 years removed forest and canebrake vegetation from along larger streams to open land for cultivation. Some of this historic forest has grown back, but little of the cane has. Sand/gravel/cobble and boulder bars are in part a function of erosional processes. Changes in vegetation along streams directly or indirectly would have altered some of the bars, possibly removing some and creating others. Stream bank conditions have changed over the last 200-300 years as a result of natural processes and cultural influences such as clearing, farming, and the building of roads. Today there are fewer miles of wooded stream bank than were present 200-300 years ago, but more exist now on the DBNF than during the early 1900s. Between about 1900 and 1930, most of the land now comprising the DBNF was cut over and burned. This undoubtedly had an effect on these habitats.

The area considered for this analysis is the land within the proclamation boundary of the DBNF.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

The management goal for the riparian area is to maintain the structural and functional integrity of riparian habitat and associated aquatic and terrestrial habitats. For this analysis, short-term refers to activities or conditions that occur within the expected life of this Plan. Long-term refers to activities or conditions that occur beyond the expected life of this Plan.

DIRECT AND INDIRECT EFFECTS

There are no direct and indirect effects that are common to all alternatives.

CUMULATIVE EFFECTS

While much of the land within the proclamation boundary of the DBNF is still wooded, including riparian areas, the National Forest System land is more likely to maintain intact riparian habitats than other lands. The need for flat land in the business and private sectors encourages the clearing and draining of flood plain and terrace lands.

Land ownership within the DBNF proclamation boundary is highly interspersed between private, state and federal entities. On a landscape scale of this proportion, the effects of the myriad actions that could occur on non-National Forest System lands within the proclamation boundary is not likely to be different. Private land uses such as development, farming, logging or mineral development are likely to occur at a time, place and rate independent of the alternatives.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Alternative A in the 1985 Plan and would be implemented while meeting or exceeding minimum protection under the Endangered Species Act and the National Forest Management Act. In this alternative, no Riparian Corridor Prescription Area (RCPA) would be established however a riparian protection area is present. This designation would provide protection of the area but would not promote activities to improve the habitat. This will have both long-term and short-term adverse effects. Without the management specific for the health and viability of organisms that need the corridor habitat, those in decline may continue in that direction and those with static populations may remain so or may begin to decline.

Without the protection provided by a RCPA, habitat fragmentation would continue to be a problem and may increase with time. This fragmentation would have long- and short-term detrimental effects on riparian communities by isolating populations and restricting movement. Ownership fragmentation would decrease because of the purchasing program of the Forest. Inholdings and other land within the Proclamation Boundary would continue to be purchased. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public’s impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

Roads, the harvest/removal of resource products, and some recreational activities may have short-term localized adverse affects on riparian ecological processes. Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. Long-term benefits should result from establishment of a more diverse and stable streamside habitat.

Wildland fire use fire would be an acceptable management tool. Wildland fires would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

CUMULATIVE EFFECTS

There would be no additional cumulative effects beyond those previously described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

With an emphasis on custodial elements, it does provide for the establishment of a Riparian Corridor Prescription Area (RCPA), see description in Aquatic Species Viability, Alternative B-1. This will provide for some protection of the riparian habitat and will help reduce habitat fragmentation. Ownership fragmentation would decrease because of the purchasing program of the Forest. In-holdings and other land within the Proclamation Boundary would continue to be purchased.

There will be no active vegetation manipulation within the RCPA except for visitor safety and to meet minimum legal requirements such as providing for the viability of plant and animal species and protection of PETS Species. Without the active manipulation for the purpose of attaining and sustaining a high diversity of habitat and species, recovery of declining species may be slow or nonexistent. There would be continued use of the Forest on a maintenance level.

New trails could be built and some old trails would be closed with a net reduction in trail miles Forestwide. All trails would be closed to off-highway vehicles. Trails, roads and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or closed. Trout stocking would not be undertaken in this alternative, resulting in short and long-term beneficial effects on the aquatic community. Mineral extraction or development would be limited, especially surface-disturbing activities. Soil baring disturbances and erosion would be minimal.

Timber harvest would occur minimally and recreation facilities and developed sites would only be maintained. This reduction in sediment producing activities would have short and long-term beneficial effects on the riparian community. Prescribed fire and riparian disturbance would be minimal except for viability needs of certain land species. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed.

The short-term establishment of a RCPA would have the long-term productivity effect of providing protected habitat for the riparian community.

CUMULATIVE EFFECTS

There are no effects specific to this alternative beyond those previously described.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative emphasizes the maintenance of ecological processes and function while providing for multiple public benefits. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA), see description in Aquatic Species Viability, Alternative B-1. This RCPA will provide for protection of the aquatic habitat and will help reduce habitat fragmentation. Ownership fragmentation would be reduced through the purchase of inholdings; this would also have both short-term and long-term beneficial effect.

Vegetation manipulation would take place for the purpose of attaining and sustaining a high diversity of riparian habitats, PETS species, and riparian-associated species. Viable populations of all native species would be attained and maintained when feasible. RCPA would be protected from damaging activities and degraded areas would be restored. In the short and long-term, this would provide for recovery of PETS species and would be very beneficial to the riparian community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public’s impacts in pursuit of it. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

Vegetation manipulation for recreation may take place after meeting ecosystem needs. This alternative would increase bare soil disturbance (vegetation management) due to the viability needs of some riparian dependent species. In the short-term this would create localized adverse impacts due to the increase in sedimentation loads to the streams. In the long-term this vegetation management would benefit species dependent on this riparian habitat.

Although mineral development would be allowed in this alternative, development of federally owned minerals would not be actively pursued. Recreation (developed and dispersed) would remain at approximately current levels. Trails, roads and facilities that are causing degradation to riparian habitat would be upgraded, adequately maintained, relocated or closed. With the emphasis of attaining and sustaining a high diversity of habitats and species there would be a beneficial effect to riparian habitat dependent species. Ownership fragmentation would be reduced through the purchase of inholdings; this would also have both short-term and long-term beneficial effect.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. Wildland fire use fire would an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these fires may cause an increase in sediment loads to adjacent streams. There should be long-term benefits through the establishment of a more diverse and stable riparian habitat.

The short-term establishment of a RCPA would have the long-term productivity effect of providing protected habitat for the riparian community.

CUMULATIVE EFFECTS

There are no effects specific to this alternative beyond those previously described.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative emphasizes the maintenance of ecological processes and function while providing for multiple public benefits with added emphasis on recreation. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA), see description in Aquatic Species Viability, Alternative B-1. This RCPA will provide for protection of the aquatic habitat and will help reduce habitat fragmentation. Ownership fragmentation would be reduced through the purchase of inholdings; this would also have both short-term and long-term beneficial effect.

Vegetation manipulation would take place for the purpose of attaining and sustaining a high diversity of riparian habitats, PETS species and riparian-associated species. Viable population of all native species would be attained and maintained when feasible. RCPA would be protected from damaging activities and degraded areas would be restored. In the short and long-term this would provide for recovery of PETS species and would be very beneficial to the riparian community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. No new sites would be considered for stocking, however. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

Vegetation manipulation for recreation may take place after meeting ecosystem needs. This alternative would increase bare soil disturbance (vegetation management) due to the viability needs of some riparian dependent species. In the short-term this would create localized adverse impacts due to the increase in sedimentation loads to the streams. In the long-term this vegetation management would benefit species dependent on this riparian habitat. Although mineral development would be allowed in this alternative, development of federally owned minerals would not be actively pursued.

Recreation (developed and dispersed) would remain near current levels. Approximately 75 miles of trails would be added to the Forestwide system. Trails, roads, and facilities causing degradation to riparian habitat would be upgraded, adequately maintained, relocated, or closed. The emphasis on attaining and sustaining a high diversity of habitats and species should benefit species that depend on riparian habitat. Alternative C-1 would give greater emphasis to recreation with long- and short-term detrimental effects on the riparian community. Funds would be shifted to recreation management while increased recreation activities and construction could disturb habitat and soil.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity as well as sustain fire-dependent communities. Wildland fire use fire would be an acceptable management tool. Wildland fires by humans would be suppressed. In the short-term these fires may cause an increase in sediment loads to adjacent streams. There should be long-term benefits through the establishment of a more diverse and stable riparian habitat.

The short-term establishment of a RCPA would have the long-term effect of protecting riparian community habitat.

CUMULATIVE EFFECTS

None beyond those previously described.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize recreational opportunities to the extent possible. It would also establish a Riparian Corridor Prescription Area (RCPA) to protect aquatic habitat and reduce habitat fragmentation. Ownership fragmentation would be reduced through the purchase of inholdings with both short- and long-term benefits. Recreation activities would likely have adverse influences on ecological processes. Ecosystem diversity and sustainability would be maintained to meet minimum protection under the Endangered Species Act and the National Forest Management Act. Once the minimums were attained, however, actions would emphasize recreational opportunities to the extent possible. As a result, more RCPA would likely be disturbed by recreational activities.

Increased vegetation management and recreation for this alternative would result in an increase in habitat disturbance. With this increase in disturbance there would be long- and short-term adverse effects to riparian habitat dependent species. This would be due to the potential increase in roads, trails and facilities. Federal mineral development would be encouraged and the private minerals would be expected to remain the same as current levels. The increase in federal mineral development would also increase disturbance to the RCPA through the construction and use of roads, and possibly through the mineral construction site as well. These disturbances would have a long-term adverse effect on the riparian community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. Also, other streams would be evaluated for additional trout stocking. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public’s impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

Ecosystem diversity and sustainability would be, at least, maintained to provide the minimum protection required by the Endangered Species Act and the National Forest Management Act. This would be beneficial, but additional efforts to attain and sustain a high diversity of habitat and species would be secondary to recreational needs and funds. Establishment of the RCPA provide long- and short-term benefits by reducing fragmentation and protecting streamside areas. Due to the priority given recreation, fewer funds would be available to promote habitat diversity. The RCPA would see more recreational development that could adversely affect the riparian community. Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. Such fires would have a short-term adverse effect from the increased disturbance of the riparian habitat. The enhancement and maintenance of biological diversity would provide long-term benefits.

The short-term establishment of a RCPA would have the long-term effect of protecting riparian community habitat.

CUMULATIVE EFFECTS

There would be no cumulative effects specific to this alternative beyond those previously described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the quality as well as quantity of resource products to maximize benefits to local and regional communities. It would establish a Riparian Corridor Prescription Area[10] (RCPA). The RCPA would generate long- and short-term benefits by reducing habitat fragmentation and protecting streamside areas. Ownership fragmentation would be reduced by the purchase of inholdings with both short-term and long-term beneficial effect.

The emphasis on commodities development could increase sedimentation levels in areas close to development activities with adverse effects on the riparian community in both the long- and short-term. Habitat fragmentation in the riparian area, stream reaches, and populations would increase as more trails, roads, facilities, and mineral extraction sites were developed. These would create additional adverse long- and short-term impacts. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Additional streams would be evaluated for trout stocking. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

Ecosystem diversity and sustainability would be maintained to meet the minimum protection required by the Endangered Species Act and the National Forest Management Act. This would be beneficial, but only at minimal levels. Additional efforts to attain and sustain a high diversity of habitat and species would be secondary to resource products needs and funding. All wildland fires would be suppressed to prevent resource damage. Prescribed fire would be used to improve plant and wildlife habitat, reduce fuels to prevent wildland fire, and prepare sites for planting or natural regeneration. While such fires would have a short-term adverse effect by causing disturbances within the RCPA, there would be long-term benefits from the enhancement and maintenance of biological diversity.

The short-term establishment of an RCPA would have the long-term benefit of providing protected habitat for riparian-associated species.

CUMULATIVE EFFECTS

There would be no effects specific to this alternative beyond those previously described.

[10] See description in Alternative B-1.

PROPOSED, ENDANGERED, THREATHENED, AND SENSITIVE SPECIES

Affected Environment

The DBNF currently monitors the effects of management actions on 32 species listed under the Endangered Species Act as "Threatened or Endangered" (Table 3 - 54). These species either now occur or have occurred on National Forest System lands or within the DBNF proclamation boundary. This species list is updated as needed and reviewed annually with the U.S. Fish and Wildlife Service (USFWS). Currently there are no species on National Forest System lands or within the DBNF proclamation boundary classified as "Proposed" for federal listing.

Table 3 - 54. Federally listed species for the DBNF.

Group	Common Name	Status	Prescription Areas Important to the Species
Mammal	Gray bat	E	1C – 1E – 1J
	Indiana bat	E	1C – 1E – 1J – 1K
	Virginia big-eared bat	E	1C – 1E – 1J –1K
Bird	Bald eagle	T	1E – 3B
	Red-cockaded woodpecker	E*	1K
Fish	Duskytail darter	E	1E
	Palezone shiner	E	1E
	Blackside dace	T	1E
Mussel	Cumberland elktoe	E	1E
	Fanshell	E	1E
	Dromedary pearlymussel	E*	1E
	Cumberlandian combshell	E	1E
	Oyster mussel	E	1E
	Yellow blossom	E*	1E
	Tan riffleshell	E	1E
	Catspaw	E*	1E
	Northern riffleshell	E	1E
	Tubercled blossom	E*	1E
	Cracking pearlymussel	E*	1E
	Pink mucket	E	1E
	Ring pink	E*	1E
	Little-wing pearlymussel	E	1E
	Clubshell	E*	1E
	Rough pigtoe	E*	1E
	Cumberland bean pearlymussel	E	1E
Plant	Cumberland sandwort	E	1C
	Cumberland rosemary	T	1E
	Eggert's sunflower	T	1K
	American chaffseed	E	1C – 1G – 1K
	White-haired goldenrod	T	1C – 3E
	Virginia spiraea	T	1E
	Running buffalo clover	E	1E – 1K

Status Codes: 'E'= species is listed as 'Endangered' under the Endangered Species Act; 'T' = species is listed as 'Threatened' under the Endangered Species Act; 'E*' means species is considered by USFWS as extirpated from DBNF.

As part of compliance with the Endangered Species Act, projects conducted on the DBNF receive site-specific analysis for impacts to each of the 32 species federally listed as Threatened or Endangered. Consultation with the U.S. Fish and Wildlife Service (USFWS) is conducted prior to project implementation.

Federal Candidate Species

Four species found on the DBNF are designated as "Candidate" species. These are species for which the USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (Table 3 - 55). These four species are also included on the Regional Forester's Sensitive species list for the DBNF. Thus, candidate species receive full consideration in the decision making process in order to ensure their viability and to preclude trends toward federal listing

Table 3 - 55. Federal candidate species for the DBNF.

GROUP	COMMON NAME	STATUS
Fish	Cumberland Johnny darter	C
Mussel	Fluted kidneyshell	C
Plant	White-fringeless orchid	C
Plant	Short's bladderpod	C

Status 'C' = the species is a candidate species for consideration of federal listing by the USFWS.

Sensitive Species

Within the DBNF proclamation boundary, the Regional Forester has designated 71 species whose range-wide viability is of concern. This list is titled the Regional Forester's Sensitive Species List. Those species, which occur or have suitable habitat on the DBNF, are shown in Table 3 - 56. This list took effect August 7, 2001, and does not require a Plan Amendment to become official. Sensitive species receive full consideration in decision making to ensure their viability and to preclude trends toward federal listing.

Table 3 - 56. Regional Forester's Sensitive Species List for the DBNF.

Group	Common Name	Prescription Areas Important to the Species
Mammal	Rafinesque's big-eared bat	1C – 1J – 1K
	Southeastern myotis	1C – 1E – 1J
	Eastern small-footed bat	1C – 1E – 1J – 1K
	Long-tailed shrew	1C – 1K
Bird	Bachman's sparrow	1K
	Peregrine falcon	1C – 1K
	Appalachian Bewick's wren	1K
Fish	Western sand darter	1E
	Eastern sand darter	1E
	Cumberland Johnny darter	1E
	Ashy darter	1E
	Spotted darter	1E
	Tippecanoe darter	1E
	Mountain brook lamprey	1E
	Northern madtom	1E
	Blotchside logperch	1E
	Longhead darter	1E
	Olive darter	1E
	Southern cavefish	1E
Mussel	Cumberland papershell	1E
	Spectaclecase	1E
	Snuffbox	1E
	Long-solid	1E
	Tennessee clubshell	1E
	Pyramid pigtoe	1E
	Fluted kidneyshell	1E
	Rabbitsfoot	1E
	Salamander mussel	1E
	Purple lilliput	1E
	Sheepnose	1E
Snail	Glossy supercoil	1K
	Shortspire hornsnail	1E
	Domed ancylic	1E
	Delicate vertigo	1C – 1K
	Cupped vertigo	1C – 1K
Crustacean	Big South Fork crayfish	1E
Insect	Helma's net-spinning caddisfly	1E
	Cliffline caddisfly	1C
	Pygmy snaketail	1E
	Appalachian grizzled skipper	1K
	Diana fritillary	1K
	Regal fritillary	1K
Vascular plant	Rockcastle aster	1E
	Spreading yellow false foxglove	1C – 1K
	American barberry	1E
	Juniper sedge	1G
	Small spreading pogonia	1C – 1K
	Stoneroot	1E – 1K
	Kentucky lady's slipper	1E
	French's shooting star	1C
	Mountain heartleaf	1E
	Butternut	1E – 1K
	Short's bladderpod	1C – 1G
	Large-flowered Barbara's buttons	1E
	Sweet pinesap	1C – 1K
	Canby's mountain-lover	1C
	White fringeless orchid	1G
	Bay starvine	1C – 1E
	Rock skullcap	1C – 1E
	Southern Oconee bells	3E
	Blue Ridge catchfly	1K
	Royal catchfly	1G – 1K
	Little mountain meadowrue	1C – 1E
	Cutleaved meadow parsnip	1K
	Sand grape	1E
	Hairy skullcap	1C – 1E – 1K
Nonvascular plant	Closter's brook-hypnum	1E
	Plagiochila austinii (a liverwort)	1C
	Sullivant's leafy liverwort	1C
	Radula sullivantii (a liverwort)	1C
	Agoyan cataract moss	1C – 1E

For the purpose of analysis in this Draft Environmental Impact Statement, affected environment is the area within the DBNF proclamation boundary.

Indicators used to evaluate effects to PETS species include the establishment of Prescription Areas designed to protect or enhance the habitat used by these species and the resulting likelihood of moving PET species populations toward recovery and to ensure Sensitive species viability and preclude their trend toward federal listing.

Environmental Effects

RESOURCE TABLES

Few PETS species are entirely dependent upon habitat present in any single Prescription Area. However, several of these Prescription Areas have been created primarily for the purpose of protecting or enhancing the habitat condition upon which these species depend, while others provide a variety of habitats even if that is not their primary purpose. Most PETS species on the DBNF reside for all or a large part of their lives in these Prescription Areas. Table 3 - 57 provides a comparison between acres in these Prescription Areas and the alternatives being considered for the 2004 Forest Plan. Programmatic consequences of general management direction associated with Prescription Areas are summarized in Table 3 - 58.

Table 3 - 57. Prescription Areas with PETS Species habitat acreage provided by alternative.

PRESCRIPTION AREA	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
1.C. Cliffline Community	111,205	111,205	111,205	111,205	111,205	111,205
1.E. Riparian Corridor	0	155,379	155,379	155,379	155,379	155,379
1.G. Rare Community	0	1,200	1,200	1,200	1,200	1,200
1.I. Designated Old-Growth	0	0	15,331	15,331	15,331	325
1.J. Significant Bat Caves	6,115	6,115	6,115	6,115	6,115	6,115
1.K. Habitat Diversity Emphasis	0	0	386,577	376,042	376,042	0
1.M. Custodial	0	394,163	0	0	0	0
2.A. Clifty Wilderness	12,646	12,646	12,646	12,646	12,646	12,646
2.B. Beaver Creek Wilderness	4,791	4,791	4,791	4,791	4,791	4,791
3.C.1. Red River W&S River Wild River Segment	863	863	863	863	863	863
3.C.3. Red River W&S River Recreational Segment	2,114	2,114	2,114	2,114	2,114	2,114
3.C.4. Proposed W&S River: Cumberland River, War Fork Creek, Rockcastle River -Scenic Rivers	5,622	5,622	5,622	5,622	5,622	5,622
3.C.5. Proposed W&S River: Rock Creek and Marsh Creek – Recreational Rivers	6,184	6,184	6,184	6,184	6,184	6,184
3.E. Red River Gorge Geological Area & National Natural Landmark	29,298	29,298	29,298	29,298	29,298	29,298
4.A. Timber Products	0	0	0	0	0	394,916
4.B. General Forest Area 1985 Plan	568,206	0	0	0	0	0

Table 3 - 58. Relative opportunity for Prescription Areas to benefit PETS species by alternative.

PRESCRIPTION AREA	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
1.C. Cliffline Community	2	2	2	2	2	2
1.E. Riparian Corridor	NA	3	3	3	2	3
1.G. Rare Community	NA	3	3	3	3	3
1.I. Designated Old-Growth	NA	1	3	3	3	3
1.J. Significant Bat Caves	2	3	3	3	3	3
1.K. Habitat Diversity Emphasis	N/A	N/A	3	3	3	N/A
1.M. Custodial	N/A	1	N/A	N/A	N/A	N/A
2.A&B. Wilderness	2	2	2	2	2	2
3.C. W&S Rivers	2	2	2	2	2	2
3.E. Red River Gorge Geological Area & National Natural Landmark	2	2	2	2	2	2
4.A. Timber Products	N/A	N/A	N/A	N/A	N/A	1
4.B. General Forest Area	2	N/A	N/A	N/A	N/A	N/A

3 = a programmatic increase in PETS species protection or habitat enhancement opportunities

2 = a programmatic no change in PETS species protection or habitat enhancement opportunities

1 = a programmatic decrease in PETS species protection or habitat enhancement opportunities

Potential impacts to PETS species can be very site-specific and individual project oriented. However, some programmatic consequences can be anticipated regarding general management emphasis associated with a particular alternative. Relative comparisons between existing Forest Plan direction and direction found in various alternatives is shown in Table 3 - 59.

Table 3 - 59. Relative opportunity to protect or benefit PETS species by functional area and alternative.

FUNCTIONAL AREA	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Recreation	2	3	3	2	1	2
Roads and trails	2	3	3	3	1	1
Fire	2	1	3	3	3	1
Minerals	2	3	3	3	2	1
Land adjustment	2	2	3	3	1	1

3 = a programmatic increase in PETS species protection or habitat enhancement opportunities

2 = a programmatic no change in PETS species protection or habitat enhancement opportunities

1 = a programmatic decrease in PETS species protection or habitat enhancement opportunities

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Several Prescription Areas utilized by PETS species remain essentially unchanged throughout all alternatives. These include Cliffline Community (1.C), Significant Bat Caves (1.J), Clifty Wilderness (2.A), Beaver Creek Wilderness (2.B), Red River Wild and Scenic River (3.C.1, 3.C.2), proposed Wild and Scenic River segments (3.C.4), and Red River Gorge Geological Area (3.E). Thus, differences in effects among alternatives do not exist for these Prescription Areas.

Site-specific analysis, through biological evaluation, would continue for proposed projects regardless of alternative. Likewise, monitoring of PETS species will be conducted according to Forest Plan and Handbook and is independent of alternative selection.

Short-term use and long-term productivity are common to all alternatives. Regardless of the alternative chosen, all projects implemented under the 2004 Forest Plan will be designed to avoid negative impacts to the long-term productivity of any PETS species population on the DBNF. Some activities designed to attain a Desired Future Condition within a Prescription Area could have short-term impacts to individual PETS species. The short-term impacts, both positive and negative, are evaluated and disclosed through second-level, site-specific analysis. Long-term productivity of PETS species populations should be enhanced through attainment of the Desired Future Condition associated with each Prescription Area.

CUMULATIVE EFFECTS

Land ownership within the DBNF proclamation boundary is highly interspersed between private, state, and federal entities. On a landscape scale of this proportion, the effects of the myriad actions that could occur off National Forest System land within the proclamation boundary is not likely to differ regardless of alternative. Private land uses such as farming, timber harvest, or mineral development are likely to occur at a time, place, and rate unrelated to National Forest System land management. In addition, actions on National Forest System lands authorized by other federal agencies (e.g., federal highways) are not expected to vary by alternative. Thus, alternative selection is unrelated to differences associated with these types of potential cumulative effects.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Several Prescription Areas, important to the maintenance or recovery of PETS species populations, would not exist under this alternative. These include Riparian Corridor, Rare Community, and Designated Old-Growth. Thus, programmatic benefits associated with management direction of these Prescription Areas would not occur.

With the absence of a Riparian Corridor Prescription Area, this alternative would likely see adverse impacts to aquatic PETS species associated with recreation, roads, trails, and other uses.

CUMULATIVE EFFECTS

There are none beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Alternative B-1 would emphasize custodial management. Some habitat management could occur within selected Prescription Areas, but overall these activities would be greatly limited in size and scope. The General Forest, Timber Products, and Habitat Diversity Emphasis Prescription Areas would not exist under this alternative. The selection of this alternative would result in a substantial reduction in acres actively managed to enhance terrestrial PETS species habitats. However, this alternative would also see the least amount of soil disturbance and the resulting potential for stream sedimentation. Thus, potential sedimentation impacts to aquatic species would be minimized under this alternative.

The Custodial Prescription Area (1M) would occur only in Alternative B-1. This prescription would call for very little habitat management, and the Forest would head slowly in the direction of older forest communities. PETS species that require younger age forest habitat or benefit from forest vegetation management tools such as prescribed fire would experience continuing declines in available habitat. Habitat management necessary only for minimum viability would be undertaken. For example, prescribed burning would be limited to only about 2,000 acres annually, and fire adapted species would likely decline from present levels in distribution and abundance.

The custodial management emphasis would likely reduce the amount of dispersed recreation on the DBNF, somewhat reducing potential harm to PETS species from human interactions.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the maintenance of ecological processes and function. Species needs, including PETS species, would be the fundamental objective of habitat management. The Habitat Diversity Emphasis Prescription Area would support a wide variety of habitat conditions across the Forest. Its primary goal would be the provision of habitat components necessary to enhance, not simply provide, habitat suitability for PETS and other species. The opportunity to move species toward recovery goals would be maximized under this alternative.

Alternative C would anticipate essentially the same recreational use that now occurs. Additional Standards, particularly within the Riparian Corridor Prescription Area, would be implemented to reduce the likelihood of adverse human impacts on PETS species. Programmatic direction within this Prescription Area would provide additional safeguards for PETS species, minimizing the potential for adverse impacts.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

Alternative C-1 would emphasize the maintenance of ecological processes and function with additional emphasis on recreation. Species needs, including PETS species, would serve as the fundamental objective of habitat management. The Habitat Diversity Emphasis Prescription Area would support a wide variety of habitat conditions across the Forest. Its primary goal would be the provision of habitat components necessary to enhance, not simply provide, habitat suitability for PETS and other species. The opportunity to move species toward recovery Goals will be very similar to that of Alternative C.

Alternative C-1 would anticipates some increase in recreational use over that in Alternative C. Additional Standards, particularly within the Riparian Corridor Prescription Area, would be implemented to reduce the likelihood of adverse human impacts on PETS species. Additional road and trail Standards would be applied within this Prescription Area to provide programmatic safeguards for PETS species. Impacts to PETS species would be very similar to those associated with Alternative C.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

Alternative D emphasizes recreational opportunities to the maximum extent possible. Although the Prescription Areas remain essentially unchanged from those included in Alternatives C and C-1, management emphasis is directed toward recreational pursuits. Thus, habitat enhancement to recover PETS species would not be as high a priority as in either Alternative C or C-1.

Recreation activities such as road and trail construction would receive additional emphasis under this alternative. Thus, there would be potential for increased stream sedimentation from these sources when compared to the other alternatives. Alternative D would include the Riparian Corridor Prescription Area with the same provisions for protecting water quality as are found in the other alternatives, excluding Alternatives A and B-1. Dispersed recreation would be maximized in this alternative, giving it the greatest potential of any alternative for adverse recreation-related impacts to PETS species and their habitats.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

The primary purpose of habitat manipulation under this alternative would commodity production rather than PETS species habitat restoration. A Prescription Area dedicated to timber production (4.A) would be established only in Alternative E. The 1985 Plan (Alternative A) contains a somewhat similar, although substantially larger Prescription Area designated as General Forest, 4.B. This alternative would not create a Prescription Area designed to maintain habitat diversity. Thus, the potential to emphasize PETS species habitat management would be substantially less under Alternative E-1 than under alternatives with the 1.K Habitat Diversity Prescription Area.

Recreational use would be emphasized in this alternative primarily through the fee use system. The potential for impacts to PETS species, through increased dispersed recreation, would likely be less than that under Alternative D, but would still be higher than in any other alternative.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

DEMAND SPECIES

Affected Environment

Current direction emphasizes the protection, enhancement, and maintenance of species and their habitats, which in turn will provide diverse opportunities for users of wildlife and fish resources. The "demand" label does not imply that a species is of greater value than a "non-demand" species. All species are always "in demand" for one or more reasons (e.g., ecological, scientific, ethical, aesthetic, recreational, commercial, legal). However, for the purpose of this chapter, "demand species" are those most associated with the recreational wildlife pursuits; i.e. hunting, fishing, and viewing activities (Table 3 - 60). Since these activities are generally limited or restricted on non-public lands, the DBNF offers a unique opportunity to those wishing to participate in these activities.

Table 3 - 60. Demand species list for the DBNF.

SPECIES GROUP	SPECIES	HABITAT GROUP	TYPE OF DEMAND
Amphibian	Bullfrog	Aquatic	Hunting
Fish	Black bass	Aquatic	Fishing
	Catfish sp.	Aquatic	Fishing
	Crappie	Aquatic	Fishing
	Muskellunge	Aquatic	Fishing
	Panfish (e.g. Bluegill, Sunfish)	Aquatic	Fishing
	Trout	Aquatic	Fishing
	Walleye	Aquatic	Fishing
	White bass	Aquatic	Fishing
Bird	Mourning dove	Terrestrial	Viewing/Hunting
	Passerine birds (Songbirds)	Terrestrial	Viewing
	Northern Bobwhite Quail	Terrestrial	Viewing/Hunting
	Ruffed grouse	Terrestrial	Viewing/Hunting
	Waterfowl	Terrestrial but utilizes Aquatic	Viewing/Hunting
	Wild turkey	Terrestrial	Viewing/Hunting
	Woodcock	Terrestrial	Viewing/Hunting
	Bald eagle	Terrestrial	Viewing
Mammal	Beaver	Terrestrial but utilizes Aquatic	Viewing/Trapping
	Black bear	Terrestrial	Viewing
	Bobcat	Terrestrial	Hunting/Trapping
	Elk	Terrestrial	Viewing/Hunting
	Gray fox	Terrestrial	Hunting/Trapping
	Gray squirrel	Terrestrial	Viewing/Hunting
	Mink	Terrestrial	Trapping
	Muskrat	Terrestrial but utilizes Aquatic	Trapping
	Rabbit	Terrestrial	Viewing/Hunting
	Raccoon	Terrestrial	Hunting/Trapping
	White-tailed deer	Terrestrial	Viewing/Hunting

The level of demand for each species or group of species varies to some degree across the Forest. Consumptive demand for species includes hunting, fishing, and trapping. A level of demand is also recognized for non-consumptive uses such as viewing, which enhances the experience of forest users.

Wildlife on the DBNF is cooperatively managed under an agreement with the Kentucky Department of Fish and Wildlife Resources (KDFWR). The agreement recognizes the Forest's responsibility "to practice forms of land and resource management that will benefit wildlife (habitats) as much as practical in coordination with the requirements of other uses and values." The agreement also recognizes KDFWR's responsibility as "the agency primarily responsible for protection and management of the Forest's wildlife (species) resources." In fulfilling the Forest's commitment under the agreement, the DBNF manages habitats for native and desirable non-native plants, fish, and wildlife species. Because the alternatives address land and resource management only on lands administered by the DBNF, this analysis of demand species is limited to National Forest System land.

Five state-designated Wildlife Management Areas lie within the Forest. KDFWR hunting regulations are applied within these areas to improve and sustain populations and meet wildlife management objectives. In addition to the recreational opportunities provided by these areas, they also serve as source population centers for restocking efforts in the state.

Hunting

To be considered huntable by the KDFWR, species must have population levels that produce some harvestable surplus. Kentucky's public lands are recognized as an important part of the land base to provide quality-hunting areas. Surveys by the KDFWR indicate that 80 percent of the annual deer harvest occurs on private lands. However, the remaining 20 percent of the harvest occurs on public lands that comprise only about five percent of the state's hunting areas. This indicates a high use of public lands for white-tailed deer hunting.

Between 1991 and 1996, hunter use days on National Forests in the Southern Region increased by about 23 percent and the expenditures (retail sales for related goods and services) have increased by over 88 percent (Maharaj 2000). Information from the KDFWR indicates that the number of licensed hunters in Kentucky has remained flat to slightly declining while hunter use days have increased. The number of statewide hunting participants between 1991 and 1996 has shown essentially no change (USFWS 1998).

Fishing

The demand for quality fishing opportunities in Kentucky has remained high as indicated by the number of fishing license sales reported by KDFWR. Between 1991 and 1996, the number of fishing participants has shown essentially no change (USFWS 1998).

The average Kentucky angler fishes about 24 days each year (1990-1991season), 15 percent more than the national average. Fishing from a boat is the method used 58 percent of the time, but non-boat fishing is still very popular. Anglers fished large reservoirs, lakes, and farm ponds (under 10 acres) most often. Cave Run Lake and Laurel River Lake are in the top 12 most fished lakes in the state. Black bass (largemouth, smallmouth, and spotted bass) are the most popular fishes in Kentucky. Fishing for muskie, walleye, and trout occurs in higher percentages in eastern Kentucky than elsewhere in the state.

A fishing trip's quality is usually measured subjectively by "the enjoyment of fishing," although the number of fish caught remains an important factor, especially when considering a return visit. Nearly half of anglers believe that habitat and water quality are the most important factors affecting fish populations. Fisheries projects that focus on habitat rehabilitation, enhancement, protection, and watershed management receive strong support from the angling public.

Trout (brown and rainbow) are generally recognized as a valuable recreational aquatic resource. All streams currently being stocked with trout on the Forest are considered put-and-take or put-grow-and-take fisheries. Numerous waters located on the DBNF are stocked with rainbow trout by the U.S. Fish and Wildlife Service and brown trout by the KDFWR and the U.S. Fish and Wildlife Service (Table 3 - 61).

Table 3 - 61. Waters currently stocked with trout on the DBNF.

WATERS	COUNTY	RAINBOW TROUT	BROWN TROUT
Bark Camp Creek	Whitley	X	X
Big Double Creek	Clay	X	
Cane Creek	Laurel	X	
Cave Run Lake	Bath and Rowan	X	
Chimney Top Creek	Wolfe		X
Craney Creek	Rowan	X	
East Fork Indian Creek	Menifee	X	X
Fishing Derby Ponds	Forest -wide	X	
Laurel River	Laurel and Whitley	X	X
Laurel River Lake	Laurel and Whitley	X	X
Little Double Creek	Clay	X	
Middle Fork Red River	Powell	X	
Minor Creek	Rowan		X
North Fork Triplett Creek	Rowan	X	
Rock Creek	McCreary	X	
Slabcamp Creek	Rowan		X
Swift Camp Creek	Wolfe	X	
Triplett Creek	Rowan	X	
War Fork	Jackson	X	

Viewing

The opportunity to view and observe wildlife is an integral and important part of many recreational activities such as hiking, hunting, fishing, camping, driving, and other outdoor activities. This factor is often identified as one criteria applied in personally evaluating the success of an outdoor experience. Rare opportunities to view little known species are also a benefit of the Forest. A disproportionately higher number of forest-associated rare species can typically be found on National Forest System lands.

The trend in the number of viewing days on National Forests in the Southern Region showed a slight decrease between 1991 and 1996. A decrease of about two percent in viewing days and 14 percent in expenditures was observed (Maharaj 2000). This follows the nationwide trend for the same period; however, the southern region showed less reduction in viewing days than was observed nationwide (16 percent). Statewide, between 1991 and 1996, the number of participants who traveled at least one mile from their residence to view wildlife remained unchanged; however, the number of participants who typically viewed wildlife near their residences declined by 20 percent (USFWS 1998).

In the spring of 1995, the University of Minnesota conducted a survey of managers on national forests throughout the nation to determine the relative importance of forest ecosystem attributes, outputs, and functions as perceived by national forest managers (Zhi Xu and Bengston 1996). Of the 19 national forest attributes identified, respondents ranked timber, wildlife and fish habitats, consumptive, and non-consumptive recreation as the top four in importance, respectively, in the Southern Region.

Viewing and photographing wildlife is the most popular non-consumptive wildlife-related activity found on the Forest. About 31 percent of the people surveyed in the National Survey on Recreation and the Environment (Fenton 1997) participated in wildlife viewing/photography and slightly fewer, 27 percent, concentrated particularly on viewing and photographing birds. The variety of wildlife viewing, photography, and study opportunities will be sustained through the planning period only to the extent that habitat diversity is maintained. Public lands of the DBNF will play an ever-increasing role in meeting the needs of outdoors enthusiasts.

To provide for the habitats of the species and groups listed in Table 3 - 60, the habitat types utilized by these species must be provided. Several of the species or groups have very specific habitat requirements; while others require a variety of habitats; while still others are very opportunistic and adaptable and can thrive in a variety of habitat types and conditions. Multiple habitat types may be necessary for some species throughout their life cycle.

The following general relationships exist for each species or group (Table 3 - 62).

Table 3 - 62. Habitats most commonly used by demand species on the DBNF.

Species Group	Species	Grassy Openings	Wooded Grasslands/ Shrublands (Pine)	Wooded Grasslands/ Shrublands (Hardwood)	Early Successional 0-10 yrs	PoleS/ Sapling 11-50 yrs	Hard Mast and Den Producing 50+ yrs	Riparian1	Aquatic	Diversity of habitats2
Amphibian	Bullfrog							X	X	
Bird	Bald eagle							X	X	
Bird	Mourning dove	X								
Bird	Other waterfowl	X						X	X	
Bird	Passerine birds (songbirds)	X	X	X	X	X	X	X		X
Bird	Quail	X			X					
Bird	Ruffed grouse				X	X				
Bird	Wild turkey	X					X			X
Bird	Wood duck						X	X	X	
Bird	Woodcock	X				X		X		
Fish	Black bass								X	
Fish	Catfish sp.								X	
Fish	Muskellunge								X	
Fish	Panfish (e.g. Sunfish, Bluegill)								X	
Fish	Trout spp.								X	
Fish	Walleye								X	
Fish	White bass								X	
Fish	Crappie								X	
Mammal	Black bear									X
Mammal	Bobcat									X
Mamma	Beaver							X	X	
Mammal	Elk	X								
Mammal	Gray fox									X
Mammal	Gray squirrel			X			X			
Mammal	Mink							X		
Mammal	Muskrat							X	X	
Mammal	Rabbit	X			X					
Mammal	Raccoon						X	X		X
Mammal	White-tailed deer	X	X	X	X		X			X

[1] For the demand species analysis, the term riparian refers to Eastern riverfront and river flood plain forested habitats and should not be confused with the Riparian Corridor Prescription Area.

[2] Indicates species will utilize a wide range of habitat types.

Because a Forest Plan provides programmatic, rather than site-specific, direction, this analysis is based on a general comparison of expected changes to associated habitat types. Environmental effects of the alternatives on demand species will be based on the number of acres of demand species habitat available at out-years 10 and 20 compared to acres currently available (Table 3 - 63). It assumes that an increase or decrease in the quantity of habitat will result in a corresponding change in populations and, in turn, a corresponding increase or decrease in the opportunity for a successful experience. There are limitations to this assumption, however. Populations are affected by many factors, such as hunting/fishing regulations; access; numbers and success of hunters/anglers; supplemental stocking of species; quality and juxtaposition of habitats; climatic conditions; insects and disease; inter and intra specific competition; and land management practices on adjacent lands. At the Forest Plan level of analysis, the factors affecting populations cannot be meaningfully measured, detected, or evaluated. Therefore, they are better left for project-specific or site-specific analysis.

Environmental Effects

RESOURCE TABLE

Table 3 - 63. Habitat currently available for demand species on the DBNF.

General Habitat Type	Acres/Miles Currently Available[1]
Grassy Openings	2171 Acres
Wooded Grasslands/Shrublands (Pine)	0 Acres
Wooded Grasslands/Shrublands (Hardwood)	0 Acres
Early successional (0-10 yrs)	56,171 Acres
Poles/Sapling (11-50 yrs)	155,360 Acres
Mast/Den producing (50+ yrs)	212,421 Acres
Riparian[2]	4,004 Acres
Aquatic – lakes	13,853 Acres
Aquatic – perennial streams	2,516 Miles

[1]Data used in this analysis were derived from the 1997 Continuous Inventory of Stand Conditions database (CISC) and the Geographic Information System (GIS). Acres are based on GIS stand polygons. Acres used in this analysis are for NF land only.

[2]For the demand species analysis, the term riparian refers to Eastern riverfront and river flood plain forested habitats and should not be confused with the Riparian Corridor Prescription Area.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Kentucky Department of Fish and Wildlife Resources (KDFWR) is responsible for the permanent and continued supply of the wildlife resources of Kentucky. Regardless of the alternative selected, KDFWR will continue to regulate hunting/fishing seasons; bag, creel, and possession limits; buying, selling, and transporting fish and wildlife; methods and devices used to take fish or wildlife; and sets areas for hunting and fishing activities. To a lesser extent, KDFWR will also continue to regulate viewing opportunities, such as their regulation(s) prohibiting the use of lights to view wildlife at night.

Riparian/Lakes/Streams

An increase in the amounts of riparian area, lakes, and streams can be accomplished only through the acquisition of additional land. Throughout all alternatives, acres in these habitat types would be expected to remain stable. All alternatives would be able to provide good quality aquatic habitat capable of supporting recreational fishing opportunities.

CUMULATIVE EFFECTS

Land ownership within the DBNF Proclamation Boundary is highly interspersed between private, state, and federal entities. On a landscape scale of this proportion, the effects of the myriad actions that could occur off National Forest System lands within the proclamation boundary are not likely to differ regardless of alternative. Private land uses such as farming, timber harvest, or mineral development are likely to occur at a time, place, and rate independent of the selection of Forest Plan alternatives.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

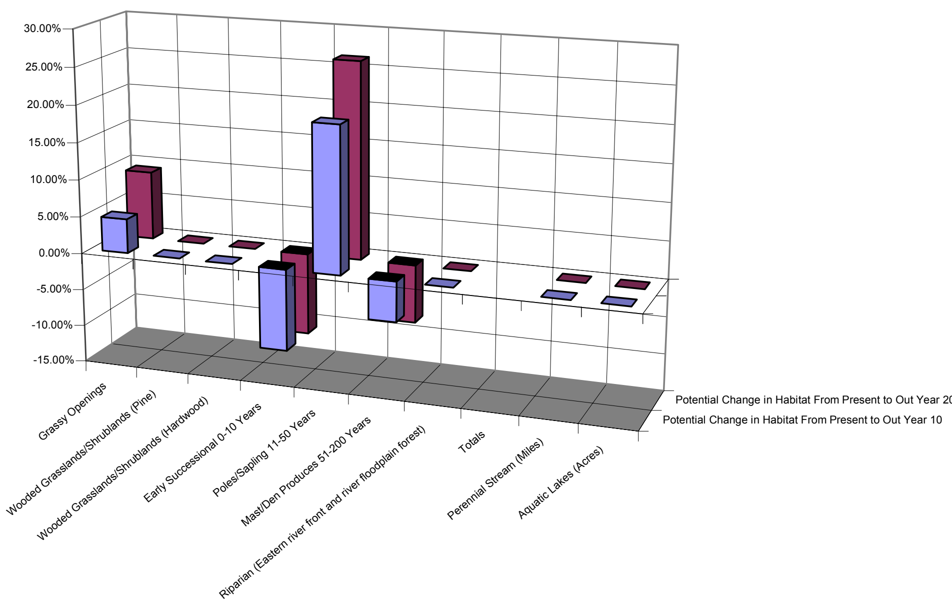

Figure 3 - 38. Potential Change in Habitat Types for Alternative A.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	4.61%	0.00%	0.00%	-10.99%	19.68%	-5.43%	0.00%	0.00%	0.00%
Potential Change in Habitat through Year 20	9.21%	0.00%	0.00%	-10.99%	26.39%	-7.78%	0.00%	0.00%	0.00%

Openings/Grassy

In addition to the existing acres, an increase of approximately 100 acres in the first decade of Plan implementation could be expected. These areas would be considered permanent and maintained in the grassy opening state. At the end of the first decade, grassy openings would comprise of less than one percent of demand species habitat.

Wooded Grasslands/Shrubland (Both Pine and Hardwood)

These types of habitat would not be created/maintained under this alternative.

Early Successional (trees 0-10 years old)

An increase of approximately 50,000 acres of this habitat type could be expected in the first decade with a leveling off during the second decade of plan implementation. The majority of the acres would be created as a result vegetation management activities primarily in the poles/saplings and mast/den types of habitat. At the end of the first decade, approximately 12 percent of demand species habitat would be of this type.

Poles/Saplings (trees 10-50 years old)

As a result of a maturing forest, a decrease of approximately 7,700 acres during each of the first two decades of plan implementation could be expected. At the end of the first decade, approximately 38 percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

As a result of vegetation management activities, a decrease of approximately 11,300 acres during the first decade and approximately 14,000 acres during the second decade of plan implementation could be expected. At the end of the first decade, approximately 49 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of stocking trout and other fish is compatible with this alternative and would more than likely continue.

CUMULATIVE EFFECTS

None beyond those described in Effects Common to All Alternatives.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

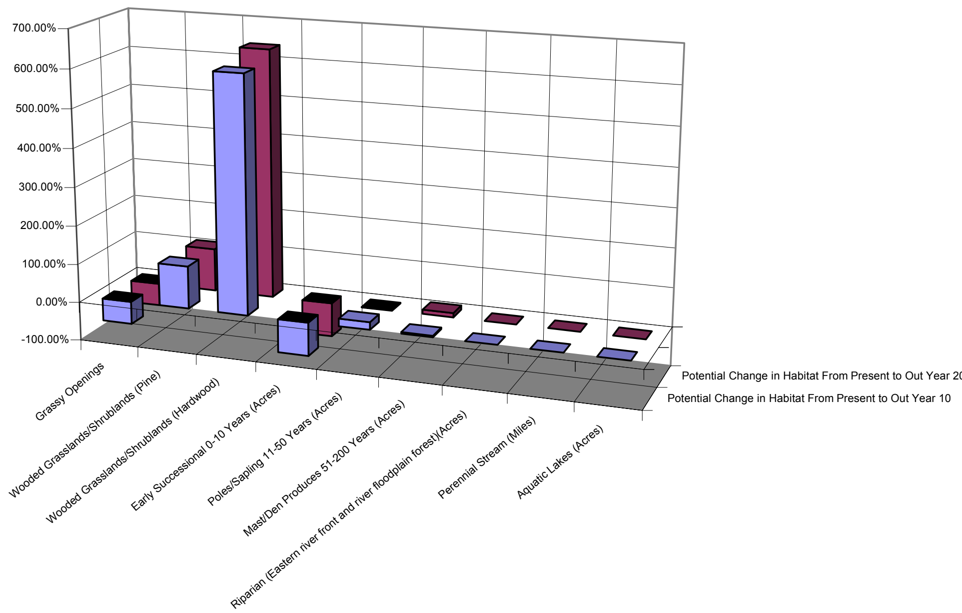

Figure 3 - 39. Potential Change in Habitat Types for Alternative B-1.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	-58.54%	110.00%	610.00%	-86.26%	19.68%	3.95%	0.00%	0.00%	0.00%
Potential Change in Habitat through Year 20	-58.54%	110.00%	640.00%	-87.32%	-1.29%	11.11%	0.00%	0.00%	0.00%

Openings/Grassy

A gradual decrease of approximately 1,300 acres of this habitat type would occur in the first 10 years of Plan implementation. These 1,300 areas would probably be nonexistent by the end of the second decade. The decrease can be attributed to the areas being overtaken by woody vegetation. In order to meet viability requirements, approximately 900 acres of this habitat type would be maintained across the Forest. At the end of the first decade, less than one percent of demand species habitat would consist of this type. While other, smaller areas may be produced by natural disturbances, they would be short lived.

Early Successional (trees 0-10 years old)

In order to meet viability requirements, approximately 700 acres of this habitat type would be maintained across the Forest. At the end of the first decade, approximately two percent of demand species habitat would consist of this type. While other, smaller areas may be produced by natural disturbances, they would be short lived.

Wooded Grasslands/Shrublands (Pine)

In order to meet viability requirements, approximately 110 acres of this habitat type would be established in the first decade and maintained throughout the second decade. While other, smaller areas could be produced by natural disturbances, they would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Hardwood)

In order to meet viability requirements, approximately 610 acres of this habitat type would be created in the first decade and maintained throughout the second decade. While other, smaller areas could be produced by natural disturbances, they would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Poles/Sapling (trees 10-50 years old)

As a result of a maturing forest, a decrease of approximately 7,700 acres during the first decades, and an additional decrease of approximately 37,400 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately forty percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

An increase of approximately 9,000 acres of this habitat type would occur in the first decade, and an additional increase of 17,600 acres during the second decade of Plan implementation. At the end of the first decade, approximately 57 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of trout stocking would be inconsistent with the management emphasis of this alternative and would not be encouraged. Should KDFWR and FWS cease stocking trout, trout fishing opportunities would likely decline as a result of previously stocked trout being caught and/or through natural mortality. At some point, trout fishing opportunities would no longer exist on the Forest.

CUMULATIVE EFFECTS

None beyond those described in the Effects Common to All Alternatives discussion.

ALTERNATIVES C, C1, D

DIRECT AND INDIRECT EFFECTS

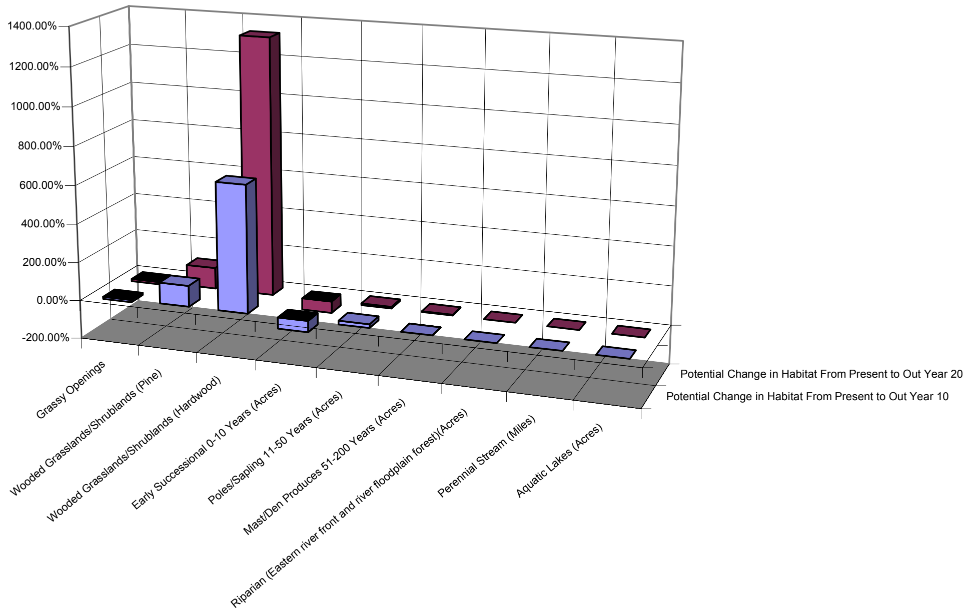

Figure 3 - 40. Potential Change in Habitat Types for Alternative C, C1, D.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	-12.48%	110.11%	660.0%	-58.97%	19.68%	0.55%	0.0%	0.0%	0.0%
Potential Change in Habitat through Year 20	-12.50%	110.11%	1330.0%	-59.10%	8.50%	4.20%	0.0%	0.0%	0.0%

Openings/Grassy

A gradual decrease of approximately 270 acres of this habitat type would occur in the first decade of implementation. Acres remaining/created in this habitat type would be considered permanent and maintained in an open state. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Pine)

In order to meet viability requirements, approximately 110 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Hardwood)

In order to meet viability requirements, approximately 610 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Early Successional (trees 0-10 years old)

An increase of approximately 3,900 acres of this habitat type would occur in the first ten years. Approximately 22,000 acres of this habitat type would be maintained across the forest throughout the second decade. The increase of acres would be primarily a result of vegetation management activities. At the end of the first decade, approximately five percent of demand species habitat would be of this type.

Poles/ Saplings (trees 10-50 years old)

As a result of maturing timber, a decrease of approximately 7,700 acres during the first decades, and an additional decrease of 24,000 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately 39 percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

An increase of approximately 1,400 acres of this habitat type would occur in the first decade, and an additional increase of approximately 21,000 acres during the second decade of Plan implementation. At the end of the first decade, approximately 55 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of stocking trout and other fish is compatible with this alternative and would more than likely continue.

CUMULATIVE EFFECTS

None beyond those described in Effects Common to All Alternatives.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

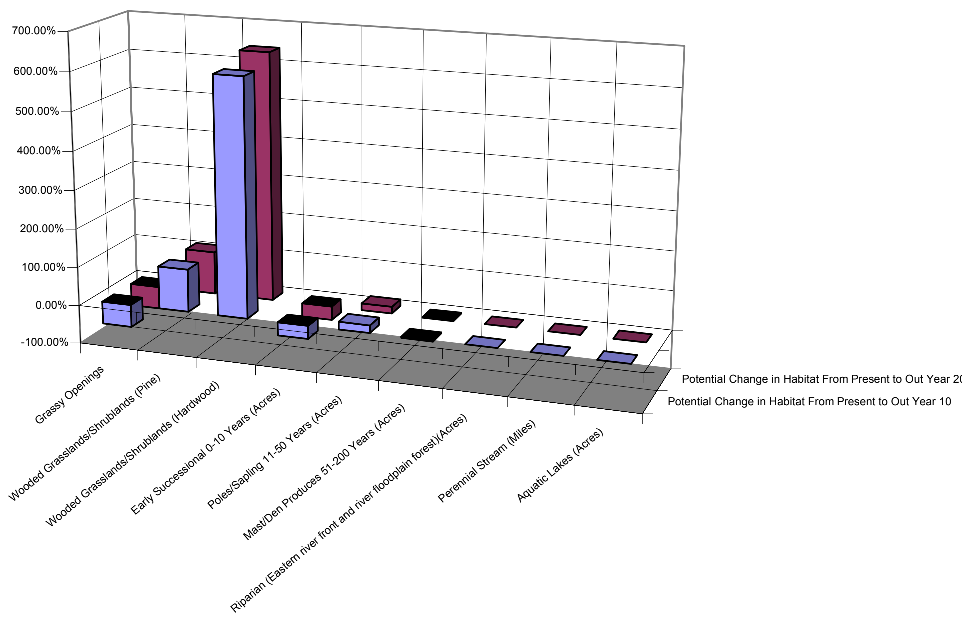

Figure 3 - 41. Potential change in habitat types for Alternative E-1.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	-58.54%	110.0%	610.0%	-33.98%	19.68%	-2.56%	0.0%	0.0%	0.0%
Potential Change in Habitat through Year 20	-58.50%	110.0%	640.0%	-35.20%	17.60%	-1.90%	0.0%	0.0%	0.0%

Openings/Grassy

A decrease of approximately 1,300 acres of this habitat type would occur in the first ten years of implementation. These areas could be nonexistent by the end of the second decade. The decrease is attributed to the areas being overtaken by woody vegetation. In order to meet viability requirements, approximately 900 acres of this habitat type would be maintained. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Pine)

In order to meet viability requirements, approximately 110 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Hardwood)

In order to meet viability requirements, approximately 610 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Early Successional (trees 0-10 years old)

An increase of approximately 18,000 acres of this habitat type would occur in the first ten years. Approximately 36,000 acres of this habitat type would be maintained across the forest throughout the second decade. At the end of the first decade, approximately nine percent of demand species habitat would be of this type.

Poles/Saplings (trees 10-50 years old)

As a result of a maturing forest, a decrease of approximately 7,700 acres during the first decade, and an additional decrease of 8,000 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately thirty nine percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

As a result of timber harvest activities, a decrease of approximately 5,211 acres during the first decade and an additional decrease of approximately 15,612 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately 51 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of stocking trout and other fish is compatible with this alternative and would more than likely continue.

CUMULATIVE EFFECTS

None beyond those described in Effects Common to All Alternatives.

PARTNERS-IN-FLIGHT LANDBIRDS

Affected Environment

BACKGROUND

Evidence of declining population trends for many landbird species has focused concern on bird conservation. For this analysis, landbirds will include all avian species found on the Daniel Boone National Forest with the exclusion of waterfowl and shorebird species. To ensure that Forest Plan Revision efforts included provisions for bird species of concern, collaboration was conducted with the Division of Migratory Birds of the U.S. Fish and Wildlife Service under the umbrella of Partners-in-Flight (PIF). PIF is a cooperative effort involving federal, state, and local government agencies, foundations, professional organizations, conservation groups, industry, and the academic community. It was launched in response to growing concerns about declines in populations of Neotropical migrant birds. It has since expanded to include the conservation of songbirds not covered by existing conservation initiatives.

Neotropical migrant birds breed in North America but spend their non-breeding period primarily south of the United States. Numerous others are short-distance migrants or only occasionally visit the DBNF as transients.

PRIORITY SPECIES

The degree to which the DBNF is able to provide and maintain a diverse spectrum of habitat conditions directly influences the variety of bird life on the forest. Limitations of the landscape setting will preclude a significant presence of some bird species. The Partners-in-Flight list of priority conservation species will provide the focus for this analysis.

PIF developed a list of 36 priority bird conservation species for the Northern Cumberland Plateau physiographic region. Species are listed by common name in a descending order based on the score in Table 3 - 64. This process helps prioritize inventory, monitoring, management, and research needs.

The system ranks each species based on seven measures of conservation vulnerability: 1) relative abundance, 2 and 3) size of breeding and non-breeding ranges, 4 and 5) threats during breeding and non-breeding seasons, 6) population trend, and 7) relative density.

To further refine species prioritization within a physiographic area, PIF applied the following criteria:

- Population trends – Trends as reported from the Breeding Bird Survey
- Area of importance – Based on both detection rate on the Breeding Bird Survey routes and distribution within and beyond the physiographic area
- Percent of Breeding Bird Survey – Within the physiographic area
- Migratory status – Long-range verses short range migrants.

Rating scores ranged from a highest overall priority of 35 for the Bewick's wren, to a moderate level of local and regional concern of 17 for the grasshopper sparrow.

Table 3 - 64. Population Trend Indicators for Priority Bird Conservation Species on the Northern Cumberland Plateau.

Priority Conservation Species	PIF Score	R8 Bird Survey 1997-2000	Driving Route Survey 1993-2000	Forest Rank*	Breeding Status**	Habitat Factors
Highest overall priority						
Appalachian Bewick's Wren	35			X		
Red-cockaded Woodpecker	31			X		
Cerulean Warbler	30	[slight increase]	stable-increasing	3	B	
Golden-winged Warbler	29			P	B, ZN	High elevations
Swainson's Warbler	28	[stable-increasing]	[fluctuating]	2-3	B	
High overall priority						
Louisiana Waterthrush	26	[increasing-stable]	[fluctuating]	4	B	
Henslow's Sparrow	26			0		Strip mines
Worm-eating Warbler	25	[stable]	[stable]	4-5	B	
Acadian Flycatcher	25	[slight increase]		4-5	B	
Wood Thrush	25	[stable]	decline-stable	4-5	B	
Prairie Warbler	25	[stable]	[stable]	4	B	Management-altered habitat
Bachman's Sparrow	25			X	B	
Kentucky Warbler	24	declining	[fluctuating-stable]	4	B	
Yellow-throated Vireo	22	[increasing]	increasing	4-5	B	
Summer Tanager	22	[stable-increasing]	[increase-stable]			
Eastern Wood-Pewee	22		[fluctuating]	4	B	
Black-throated Blue Warbler	22				ZN	
Hooded Warbler	22	[stable]	[stable]	5	B	
Physiographic area priority						
Red-headed Woodpecker	21		[stable-fluctuating]			
Yellow-breasted Chat	21	[stable]	declining	4	B	Management-altered habitat
Field Sparrow	21	[fluctuating]	[stable]	3-4	B	Management-altered habitat
Northern Bobwhite	20	[declining]		3-4		Habitat is naturally limited
Gray Catbird	20	[declining-stable]	[fluctuating-declining]			
Black-and-white Warbler	20	[stable]	[stable-increasing]			
Ruby-throated Hummingbird	19	[stable]	[stable]			
American Redstart	19	[slight increase]	[fluctuating]			
Eastern Towhee	19	increase	declining			
Monitoring Priority						
Yellow-throated Warbler	21	increase	[stable]	4	B	
Global priority						
Prothonotary Warbler	21		[stable]	?		
Chuck-will's-widow	19			2	B	Habitat is naturally limited
Local or regional interest						
Common Raven	---			1		Pine Mountain
Whip-poor-will	20		declining-stable	4	B	
Chestnut-sided Warbler	20	[declining]	[fluctuating-decline]			
Blackburnian Warbler	19				ZN	
Grasshopper Sparrow	17					
Northern Harrier	---					

*Forest Rank Codes:

? = Unranked on the Forest

0 = No known occurrences on the Forest

1 = Extremely rare; critically imperiled on the Forest; generally 1-5 occurrences

2 = Very rare or imperiled on the Forest, generally 6-20 occurrences

3 = Rare and uncommon on the Forest, generally 21-100 occurrences

4 = Widespread, abundant, and apparently secure on Forest

5 = Demonstrably secure on the Forest

H = Historical records on the Forest, may be rediscovered

P = Potential for occurrence on the Forest

X = Extirpated from the Forest, not likely to be rediscovered

**Breeding Status Codes:

B = Breeds on the Forest

ZN = Transient

Of these 36 priority species, habitat on the DBNF currently helps sustain populations of 24 breeding species. Others are either not forest-associated species, or are limited by elevation or extirpated. Some are not known to have occurred on the forest.

Population trends for most species of concern known to occur on the DBNF have been assessed locally using the R8 Bird Survey and Driving Route Survey. Results indicate that eight of these species show some sign of decline on the forest. One species (red-cockaded woodpecker) was recently extirpated due to the loss of the yellow pine component on the forest resulting from an outbreak of the southern pine beetle. On the other hand, the golden-winged warbler was found for the first time on the forest during 2002. This may indicate a need to assess habitat conditions specific to these species.

The recently developed "forest rankings" by NatureServe (NatureServe 2002) offers another assessment of these species of concern. This forest-specific status determination was conducted cooperatively with State Heritage Agencies. Forest rankings provide an independent assessment of rarity as determined by experts outside the Forest Service.

Table 3 - 65 links management activities addressed in the evaluation of each Alternative to the above list of concern species.

Table 3 - 65. Cross reference of habitat/management parameters (Table 3-68) with primary concern species (Table 3-66).

PARAMETERS	MANAGEMENT ACTIVITIES	PRIMARY SPECIES OF CONCERN *
Streams & Riparian	In riparian habitat, provide a relatively open understory condition, which includes shrubs such as rhododendron and mountain pepperbush, within 75-150 ft. of perennial streams.	ACFL, LOWT
	Avoid creating openings and roads within riparian hemlock stands.	CERW, WEWA, ACFL, WOTH, KEWA, EAWP, BTBW, HOWA, YTWA, BHVI
	Develop and maintain at least 80% of the Hemlock-White Pine type in a mature/old-growth condition, with a thick shrub sapling understory.	CERW, WEWA, ACFL, WOTH, KEWA, EAWP, BTBW, HOWA, YTWA, BHVI
Grassland	Wooded grassland, woodland, and grassy openings will provide habitat to support open forest grassland species.	HESP, FISP, NOBO, GRSP, NOHA
	Emphasize restoration and maintenance of warm season grasslands to the extent practical. Rehabilitate fescue dominated areas, such as strip mine areas and other openings.	HESP, FISP, NOBO, GRSP, NOHA, BEWR, GWWA, PRAW, YBCH, GRCA, EATO, CSWA
Fire	Develop and maintain the pine-grassland forest community using prescribed fire.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Develop an open canopy savannah forest with a dense understory and semi-open shrub layer.	PRAW
	Develop and maintain an open grassland-savannah habitat in large units to support associated species.	HESP, FISP, NOBO, GRSP, NOHA
	Apply fire and thinning to develop and maintain the pine-grassland community.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
Pine	Restore shortleaf and pitch pine to suitable sites.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Implement artificial regeneration methods to supplement natural regeneration of yellow pine.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Thin young yellow pine stands to stimulate growth.	RCWO
	Where opportunities arise, replace less desirable or off-site pine species with desirable, native pine species.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Restore and maintain about an 18-24% pine dominated forest types on suitable sites as historically distributed.	WEWA, WOTH, KEWA, YTVI, SUTA, EAWP, BTBW, HOWA, BWWA, RTHU, WPWI AMRE, LOWT, ACFL, RHWO, CWWI, BLBW, CORA, CERW, BHVI, RCWO
Shrub Habitat	Maintain an early succession shrub-sapling habitat condition on the Forest with an optimal patch size of 25 acres, ranging from 10-40 acres. Group or localize harvest sites to concentrate early successional habitat conditions. Locate regeneration areas outside or at the periphery of interior mature forest habitat.	BEWR, GWWA, PRAW, YBCH, GRCA, EATO, CSWA
	Provide semi-open canopy with dense woody understory maintained by periodic disturbance in moist ravines and bottomland riparian with deep shade and dense vegetation, including canebrakes.	SWWA
	Schedule shrub-sapling areas on a 5-year schedule (regeneration).	BEWR, GWWA, PRAW, YBCH, GRCA, EATO, CSWA
Mature Forest	Thin mesic oaks and mixed mesophytic hardwood forest to perpetuate a semi-open canopy and sustain a dense understory layer.	KEWA
	Manage to provide old-growth habitat representation across the Forest, representative of all major forest habitats.	WEWA, WOTH, KEWA, YTVI, SUTA, EAWP, BTBW, HOWA, BWWA, RTHU, WPWI AMRE, LOWT, ACFL, RHWO, CWWI, BLBW, CORA, CERW, BHVI, RCWO
Management Practices	Provide for forest interior species by grouping or localize harvest sites. Concentrate early successional habitat outside or at the periphery of mature interior forest.	WEWA, WOTH, KEWA, YTVI, SUTA, EAWP, BTBW, HOWA, BWWA, RTHU, WPWI AMRE, LOWT, ACFL, RHWO, CWWI, BLBW, CORA, CERW, BHVI, RCWO
	Provide and maintain representation of all successional stages and natural vegetative diversity.	ALL

*Species of Primary Concern. Standard name abbreviations from the American Ornithological Union.

Some species listed above are also Management Indicator Species: ACLF, CERW, FISP, NOBO, PRAW, YBCH, EATO, and SUTA.

COMMUNICATIONS TOWERS

Communications towers are a documented source of mortality for migratory birds. Two mechanisms of bird mortality commonly occur at communications towers. Birds flying in poor visibility conditions may not see the structure (i.e., blind collision). Towers lighted at night for aviation safety may help reduce blind collisions, but they bring about a second mechanism for mortality. Low cloud ceilings or foggy conditions refract light, creating an illuminated area around the tower. Migrating birds can then lose their stellar cues for nocturnal migration. With no broad orienting perspective on the landscape, the lighted area around a tower may be the strongest cue for navigation, and birds may linger in the illuminated space. As more and more passing birds concentrate into the relatively small, lighted space, mortality can occur when birds collide with the structure, guy wires, or even other migrating birds. The lights apparently do not attract birds from afar, but hold birds that pass within the vicinity.

ANALYSIS AREA

For the purpose of assessing the effects on PIF landbirds, the area that affects the Alternatives or that is being affected by the Alternatives includes all lands within the DBNF proclamation boundary.

Environmental Effects

Because migratory and resident landbirds are so ubiquitous and diverse, they are relevant to the majority of ecological communities and habitat elements considered during forest planning. Accordingly, provisions for these species are integrated into numerous Forest Plan Objectives and Standards focused on achieving desired habitat conditions.

RESOURCE TABLE

Each Alternative promotes a different combination of habitat conditions. The 21 habitat parameters and management activities identified in Table 3 - 66 can be used to improve overall Forest conditions for avian species of concern. These habitat parameters, developed collaboratively with the U.S. Fish and Wildlife Service, Division of Migratory Birds, were largely taken from the Northern Cumberland Plateau Bird Conservation Plan. Each Alternative would provide for these habitat elements to varying degrees. The Alternatives were evaluated on their ability to provide suitable habitat within management limitations in the following order:

0 = No appreciable habitat contribution

1 = Minimal habitat contributions

2 = Partial level of habitat provided

3 = Near optimal habitat provisions.

Table 3 - 66. Management activities, by Alternative, which will benefit DBNF birds considered by Partners-in-Flight to be Priority Bird Conservation Species (Northern Cumberland Plateau Bird Conservation Plan, November 28, 2000).

	Alternative Benefit Score*						Rationale					
MANAGEMENT ACTIVITY	A	B-1	C	C-1	D	E-1	Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Streams & Riparian In riparian habitat, provide a relatively open understory condition, which includes shrubs such as rhododendron and pepperbush, within 75-150 ft. of perennial streams.	1	2	3	3	2	2	Potential streamside vegetation manipulation & disturbance.	Reduced streamside management emphasis.	Riparian management to provide a streamside shrub component for stream associated bird species.	Riparian management to provide a streamside shrub component for stream associated bird species.	May have increased streamside recreational disturbances.	Reduced streamside management emphasis.
Avoid creating openings and roads within riparian hemlock stands.	1	2	2	2	1	2	Potential roading in bottomland/riparian hemlock stands.	Existing roads, except where viability concerns may exist.	Reduce riparian roading and void new construction in white pine-hemlock stands.	Reduce riparian roading and void new construction in white pine-hemlock stands.	Reduce riparian roading and void new construction in white pine-hemlock stands. Potential exists for recreational roading.	Reduce riparian roading and void new construction in white pine-hemlock stands.
Develop and maintain at least 80% of the Hemlock-White Pine type in a mature/old-growth condition, with a thick shrub sapling understory.	1	3	2	2	2	2	Suitable for the production of timber, 70-year rotation age.	All riparian hemlock-white pine will tend to old age conditions.	Management provision for mature/old-growth hemlock-white pine.	Management provision for mature/old-growth hemlock-white pine.	Management provision for mature/old-growth hemlock-white pine.	Management provision for mature/old-growth hemlock-white pine.
Grassland Wooded grassland, woodland, and grassy openings will provide habitat to support open forest grassland species.	0	0	2	2	2	0	No large grassland areas.	No large grassland areas.	83,300 acres of savannah and woodland habitat managed in the pine and oak types, contributing to the support of grassland associated species.	83,300 acres of savannah and woodland habitat managed in the pine and oak types, contributing to the support of grassland associated species.	83,300 acres of savannah and woodland habitat managed in the pine and oak types, contributing to the support of grassland associated species.	No large grassland areas.
Emphasize restoration and maintenance of warm season grasslands to the extent practical. Rehabilitate fescue dominated areas, such as strip mine areas and other openings.	0	0	3	3	2	0	Outside of DFC, low priority.	Outside of DFC, low priority.	Convert fescue & sericea lespedeza to warm season grasses.	Convert fescue & sericea lespedeza to warm season grasses.	Convert fescue & sericea lespedeza to warm season grasses, within reduced habitat mgt. budgets.	Outside of DFC, low priority.

	Alternative Benefit Score*						Rationale					
MANAGEMENT ACTIVITY	A	B-1	C	C-1	D	E-1	Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Fire Develop and maintain the pine-grassland forest community using prescribed fire.	1	1	3	3	3	1	Limited minimum level burn acres forestwide.	Limited minimum level burn acres forestwide.	Restore & manage yellow pine dominant forest, with fire.	Restore & manage yellow pine dominant forest, with fire.	Restore & manage yellow pine dominant forest, with fire.	Limited minimum level burn acres forestwide.
Develop an open canopy savannah forest with a dense understory and semi-open shrub layer.	1	1	3	3	3	1	Limited minimum level burn acres forestwide.	Limited minimum level burn acres forestwide.	Savannah/woodland conditions (pine & oak types) will provide a grassland habitat component, contributing to the support of the prairie warbler.	Savannah/woodland conditions (pine & oak types) will provide a grassland habitat component, contributing to the support of the prairie warbler.	Savannah/woodland conditions (pine & oak types) will provide a grassland habitat component, contributing to the support of the prairie warbler.	Limited minimum level burn acres forestwide.
Develop and maintain an open grassland-savannah habitat in large units to support associated species.	1	1	2	2	2	1	Limited minimum level burn acres forestwide.	Limited minimum level burn acres forestwide.	24,500 acres of savannah (pine & oak types) managed to provide a grassland habitat condition.	24,500 acres of savannah (pine & oak types) managed to provide a grassland habitat condition.	24,500 acres of savannah (pine & oak types) managed to provide a grassland habitat condition.	Limited minimum level burn acres forestwide.
Apply fire and thinning to develop and maintain the pine-grassland community.	3	1	3	3	3	1	A significant grass component will not occur in the pine type due to production stocking.	Custodial emphasis will limit improvement opportunities for pine.	Thinning and burning will be used to maintain the pine savannah habitat condition.	Thinning and burning will be used to maintain the pine savannah habitat condition.	Thinning and burning will be used to maintain the pine savannah habitat condition.	Pine thinning and burning will occur to promote timber production and reduce potential for catastrophic wildfire.
Pine Restore shortleaf and pitch pine to suitable sites.	3	0	2	2	2	1	About 21% of the forest is planned for pine management.	Custodial emphasis will limit pine restoration.	About 12% of the matrix area will be managed in pine and pine-hardwood forest types.	About 12% of the matrix area will be managed in pine and pine-hardwood forest types.	About 12% of the matrix area will be managed in pine and pine-hardwood forest types.	Pine is medium value, minimal restoration for viability purposes only.
Implement artificial regeneration methods to supplement natural regeneration of yellow pine.	3	0	2	2	2	1	Most pine regeneration will be artificial to control stocking and apply genetically improve seedlings.	Custodial emphasis will limit potential for pine restoration.	Most pine restoration will require site preparation and planting.	Most pine restoration will require site preparation and planting.	Most pine restoration will require site preparation and planting.	Pine restoration will be very limited, and accomplished using artificial methods.
Thin young yellow pine stands to stimulate growth.	0	0	2	2	2	0	Economically a low treatment priority.	Not appropriate under custodial management.	Desired TSI treatment to develop suitable RCW foraging habitat and accelerate tree growth.	Desired TSI treatment to develop suitable RCW foraging habitat and accelerate tree growth.	Desired TSI treatment to develop suitable RCW foraging habitat and accelerate tree growth.	Uneconomical, very low treatment priority.

MANAGEMENT ACTIVITY	Alternative Benefit Score* A	B-1	C	C-1	D	E-1	Rationale Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Where opportunities arise, replace less desirable or off-site pine species with desirable, native pine species.	0	0	2	2	2	0	Based on the economics and site-specific timber sales opportunities.	Not appropriate under custodial management.	Restoring pine on appropriate and suitable sites is a priority in addressing biodiversity.	Restoring pine on appropriate and suitable sites is a priority in addressing biodiversity.	Restoring pine on appropriate and suitable sites is a priority in addressing biodiversity.	Long-term, based on the economics of site specific timber sales.
Restore and maintain about an 18-24% pine dominated forest types on suitable sites as historically distributed.	3	1	3	3	3	2	Long-term objectives in the 1985 Plan are: 21% Y.Pine and 6% mixed.	Minimal pine restoration under custodial management. Without an active prescribed burning program (custodial) composition will tend to hardwood.	Provides for about a 20-25% pine dominate forest.	Provides for about a 20-25% pine dominate forest.	Provides for about a 20-25% pine dominate forest.	Provides for about 12% of the forest matrix in pine.
Shrub Habitat Maintain an early succession shrub-sapling habitat condition on the Forest with an optimal patch size of 25 acres, ranging from 10-40 acres. Group or localize harvest sites to concentrate early successional habitat conditions. Locate regeneration areas outside or at the periphery of interior mature forest habitat.	3	0	2	2	2	3	About a 10% harvest and regeneration rate per 10 year period.	No harvest and regeneration planned, with about a 1% natural disturbance component.	About a 5% harvest and regeneration rate per 10 year period.	About a 5% harvest and regeneration rate per 10 year period.	About a 5% harvest and regeneration rate per 10 year period.	About a 10% harvest and regeneration rate per 10 year period.
Provide semi-open canopy with dense woody understory maintained by periodic disturbance in moist ravines and bottomland riparian with deep shade and dense vegetation, including canebrakes.	2	0	3	3	3	0	Shrub development will result from timber production objectives in the 100-year flood plain.	Riparian habitat manipulation is limited within custodial management.	Develop canebrakes and dense woody understory patches in riparian habitat.	Develop canebrakes and dense woody understory patches in riparian habitat.	Develop canebrakes and dense woody understory patches in riparian habitat.	Reduced emphasis on veg. manipulation in riparian areas.
Schedule shrub-sapling areas on a 5-year schedule (regeneration).	2	0	1	1	1	2	10 year order-of-entry affecting about 1% of the matrix acres annually.	Activities scheduled as needed to meet minimal disturbance objectives.	10-year order of entry affecting about 0.5% of the matrix acres annually.	10-year order of entry affecting about .5% of the matrix acres annually.	10-year order of entry affecting about .5% of the matrix acres annually.	10 year order-of-entry affecting about 1% of the matrix acres annually.

MANAGEMENT ACTIVITY	Alternative Benefit Score* A	B-1	C	C-1	D	E-1	Rationale Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Mature Forest Thin mesic oaks and mixed mesophytic hardwood forest to perpetuate a semi-open canopy and sustain a dense understory layer.	1	1	3	3	3	1	Thinning provided, but low priority in management.	Existing forest composition and structure (no thinning).	Thinning in mesic oak and mixed mesophytic types prescribed. Mid-density upland forest to be maintained at 60-90 BA.	Thinning in mesic oak and mixed mesophytic types prescribed. Mid-density upland forest to be maintained at 60-90 BA.	Thinning in mesic oak and mixed mesophytic types prescribed. Mid-density upland forest to be maintained at 60-90 BA.	Thinning provided, but low priority in management.
Manage to provide old-growth habitat representation across the Forest, representative of all major forest habitats.	1	3	3	3	3	2	No designated old-growth.	Entire forest will move toward old-growth, within limits of natural disturbance.	Dry-mesic oak, mixed mesophytic hardwood, and beech forest types are designated for old-growth management.	Dry-mesic oak, mixed mesophytic hardwood, and beech forest types are designated for old-growth management.	Dry-mesic oak, mixed mesophytic hardwood, and beech forest types are designated for old-growth management.	A representative beech component is designated for old-growth management.
Management Practices Provide for forest interior species by grouping or localize harvest sites. Concentrate early successional habitat outside or at the periphery of mature interior forest.	1	3	2	2	2	1	Regeneration harvest is planned at about 10% per 10-year period.	A minimum amount of harvest planned, mostly natural disturbance events.	40-acre regeneration harvest opening limitation, about 5% per 10-year period. Most of the matrix forest will be in a high canopy forest condition, providing large areas of interior habitat.	40-acre regeneration harvest opening limitation, about 5% per 10-year period. Most of the matrix forest will be in a high canopy forest condition, providing large areas of interior habitat.	40-acre regeneration harvest opening limitation, about 5% per 10-year period. Most of the matrix forest will be in a high canopy forest condition, providing large areas of interior habitat.	Regeneration harvest is planned at about 10% per 10-year period.
Provide and maintain representation of all successional stages and natural vegetative diversity.	1	1	3	3	3	2	Lack well distributed old age structure.	Minimal provisions for early seral forest species.	Optimal biological diversity within forest management limitations.	Optimal biological diversity within forest management limitations.	Optimal biological diversity within forest management limitations.	Old age forest structure is under represented.
Total Score:	29	20	51	51	48	25						
Average Score:	1.4	1.0	2.4	2.4	2.3	1.2						

* Scoring Criteria: 0 = No appreciable habitat contribution; 1 = Minimal habitat contributions; 2 = Partial level of habitat provided; 3 = Near optimal habitat provisions within management limitations.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Existing communication towers on the Forest are potential sources for mortality of migratory birds. Towers exist, or in the future may be placed, at 14 locations on the Forest. These sites include 14 towers, distributed from Morehead to near Manchester. Most are owned by the state of Kentucky and operated as part of the Kentucky Emergency Warning System. The Rural Electric Cooperative Corporation operates one of the two towers at McKee. AT&T operates one tower south of Parkers Lake on the Stearns District.

CUMULATIVE EFFECTS

Interest in tower construction is expected to grow on the Daniel Boone and elsewhere. Potential adverse effects from new construction on migrating bird populations can be expected. Any new requests for tower construction on the Forest will be addressed through a special use authorization application process.

Because migratory birds cover such large areas, their conservation is dependent on the distribution of suitable habitats across large regions. Currently, National Forests provide some of the largest blocks of forested habitat when viewed on a regional scale. As habitat quality and quantity continue to decline on many private lands, National Forest System lands will become more critical to migratory birds in the future.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Under this Alternative the 1985 Plan would continue to be implemented, only partially addressing habitat needs for bird species of concern. Alternative A scored an average 1.4 of a possible 3 points toward meeting habitat provisions for landbirds (See parameters in Table 3 - 66). Some habitat provisions were fully addressed by the Alternatives, such as maintaining adequate representation of early aged forest and associated shrub habitat conditions.

This Alternative would provide a diverse age-class structure, with the exception of old-growth, throughout the Forest with potential for about 9 percent in each 10-year age class. Shrub/sapling species associated with early-aged forest habitat, such as the yellow-breasted chat and eastern towhee, should prosper from an abundance of suitable conditions well distributed across the Forest. The mature forest character should evolve into a closed canopy structure with a limited or relatively open understory. Thinning would be applied primarily on an economic basis. Species such as the ovenbird and red-eyed vireo should do well. Forest species that nest and forage in the shrub layer would be reduced, however. With the exception of maintained openings, grassland conditions are not a normal part of the DBNF. Controlled burning is a tool used on the Forest almost exclusively in the upland pine and pine-hardwood forest types.

Riparian area management in Alternative A would be applied to a streamside zone, primarily to maintain water quality. Riparian areas would be designated as suitable for timber production, under a scheduled harvest. This could reduce habitat quality for species such as the Acadian flycatcher as well as interrupt habitat connectivity at harvest sites.

Pine restoration would be emphasized within the Red-cockaded Woodpecker Habitat Management Area in Alternative A. An estimated 40,000+ acres of mature pine-dominated habitat would be required to meet population recovery objectives. All Alternatives would move the Forest toward some level of long-term pine restoration. One primary collective difference is that Alternative A would concentrate pine restoration on a designated area based on recent historic distribution of the red-cockaded woodpecker. The other Alternatives would first endeavor to re-establish the pine forest on suitable sites and then, at some long-term date, assess and delineate management opportunities for the red-cockaded woodpecker. This could potentially reduce habitat connectivity for the RCW during the 10-year Plan period, pushing recovery efforts further into the future.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

The overall emphasis in this alternative is custodial in nature with a minimum of direct human influence. Alternative B-1 scored an average 1.0 out of a possible 3 in addressing habitat improvement parameters (See parameters in Table 3 - 66). This minimal score results primarily from the passive nature of custodial management. Under this management scenario, the Forest would trend toward old age conditions over time. Limited stand replacement disturbances would occur randomly across the landscape, limited to some degree by land-use patterns. Early-aged forest conditions and grassland habitat types would diminish, as would the many disturbance dependant bird species such as the yellow-breasted chat and eastern towhee. Grassy conditions would be found mostly in maintained sites such as utility rights-of-way and recreational openings. High-canopy forest nesting and foraging species should prosper. The understory shrub layer would gradually decline as the tree canopy closes. Shrub species like the hooded warbler and wood thrush would decline, finding suitable habitat mostly in tree-fall gaps and other limited disturbance sites.

Disturbance habitat species, including many high priority bird species, would be reduced, adding to the growing concern over declining population trends. Forest composition would gradually become more homogeneous, converting to shade-tolerant species and the loss of oaks. As the forest ages, large areas would eventually undergo massive changes in composition, resulting in erratic population fluctuations caused by insect infestations and disease. There would also be increased potential for the spread of insect and disease outbreaks to adjacent private lands.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVES C, C-1, D

DIRECT AND INDIRECT EFFECTS

These alternatives emphasize the maintenance of ecological processes and function while providing for multiple public benefits. About half of the forest would be actively managed and result in a relatively moderate level of habitat fragmentation. These Alternatives effectively meet most of the habitat improvement needs for landbirds on the Forest (Table 3 - 66), scoring 2.4, 2.4, and 2.3, respectively. These three Alternatives provide for a wide variety of habitat essential to sustaining the complex assemblage of forest birds found on the Northern Cumberland Plateau. Primary habitat components provided in support of priority bird species include:

1) Early seral forest conditions, both seedling and sapling habitat types, e.g., stand harvest and regeneration
2) Mature forest conditions with large trees, e.g., large snags, tree-fall-gaps, and high canopy structure
3) Semi-open high canopy structure to develop and maintain an understory shrub component, e.g., thinning and woodland conditions
4) Riparian habitat, e.g., shrub component, old/mature hemlock, connectivity
5) Pine component, e.g., pine restoration, fire maintained pine/hardwood habitat
6) Native grasses, including the warm-season grass community, e.g., openings and wooded grassland/shrubland habitat.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

With a management emphasis on production of goods and services, this alternative would only partially address habitat needs for bird species of concern. It collectively scored an average of 1.2 out of 3 toward meeting overall habitat improvement needs for landbirds. Some habitat provisions would be fully addressed by this Alternative, such as maintaining adequate representation of early-aged forest and associated shrub habitat conditions.

With the exception of well distributed old-growth, this Alternative would provide for a diverse age-class structure throughout the forest with potential for about 10 percent in each 10-year age class. Shrub/sapling species associated with early-aged forest habitat, such as the yellow-breasted chat and eastern towhee, would prosper with an abundance of suitable conditions distributed across the forest. The mature forest character would evolve into a closed canopy structure with a limited or relatively open understory. Thinning would be applied primarily on an economic basis. Species such as the ovenbird and red-eyed vireo would do well. Forest species that nest and forage in the shrub layer would be reduced. With the exception of maintained openings, grassland conditions are not normally part of the DBNF. Controlled burning on the forest is a tool used almost exclusively in the upland pine and pine-hardwood forest types. After burning, shrubs sprout vigorously.

The riparian area would be managed under provisions of the Riparian Corridor Prescription Area. Retention of the high canopy riparian forest would provide a degree of connectivity across the forest for species associated with the mature forest structure.

CUMULATIVE EFFECTS

None beyond those already described.

FRAGMENTATION

Affected Environment

Fragmentation, as related to forest management, results in habitat conversion, habitat discontinuity, and eventually the isolation or insularization of the original habitat. The process of fragmentation can occur across a range of landscape patterns. At one extreme, small disturbance patches that disrupt habitat continuity represent it. At the other extreme, widespread habitat conversion leaves only isolated remnants of the original habitat.

The concept of fragmentation is derived from the definition of habitat. Habitat is defined relative to an organism or group of organisms, and its definition will vary from broad to specific. Within the context of forest management, we can consider:

- Fragmentation of forested land by non-forest land uses
- Fragmentation of forest types or communities
- Fragmentation of forest age-classes or seral stages.

These three types of fragmentation have different effects. Fragmentation resulting from the conversion to non-forest land uses has the most impact on biodiversity by changing existing habitat for long periods or even permanently, while the remaining forest is left in smaller, more isolated patches (Figure 3 - 42, A). This type of fragmentation occurred mostly during early European settlement when forests were cleared for agricultural and industrial uses. Fragmentation of community types can have both beneficial and adverse effects, depending upon temporal and spatial considerations. A small inclusion of one habitat type in a large block of another type (e.g., a spring in a large dry forest) can provide a microhabitat that increases the biodiversity in an area. Also a dry forest community invading a barren or glade community, under fire suppression, can greatly reduce the biodiversity of the rare glade community. Fragmentation of forest age classes, which leaves a forest matrix intact but with different age classes or seral stages (Figure 3 - 42, B), can also have both beneficial and adverse effects, depending on species, spatial, and temporal considerations (USDA Forest Service 1995).

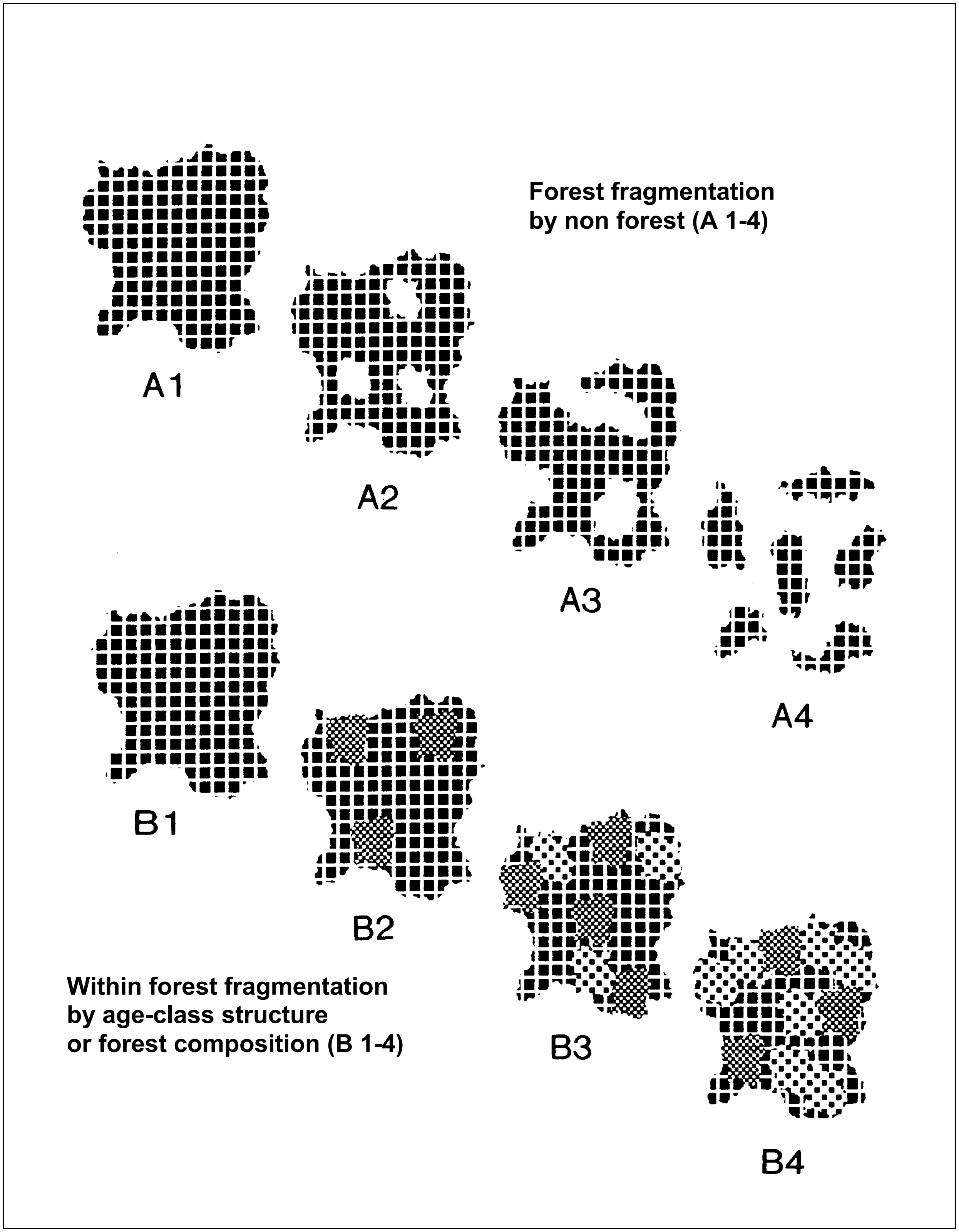

Figure 3 - 42. Types and Degrees of Fragmentation (USDA Forest Service 1995).

The issue of fragmentation may become exceedingly complex in examining potential spatial relationships and species behavioral characteristics within terrestrial habitats. To help simplify the issue and give focus to the primary concerns of fragmentation, this analysis is grouped to address effects as generated by non-forest land uses (forest fragmentation) and within forest effects of fragmentation.

FOREST FRAGMENTATION

Forest fragmentation, the division or isolation of forested land by non-forest land uses, is a subset of habitat fragmentation.

The amount of forest cover in an area and arrangement of forested areas in regard to farmland, urban, and residential land influences the mixture of plant and animal species. When forest tracts are widely separated by other land-use types or when forest constitutes only a small amount of the total cover, an area is considered a fragmented forest. A large forest area can become fragmented if land that once grew trees is converted to non-forest areas such as shopping centers, housing developments, parking lots, or major highways. Forest fragmentation may isolate populations of plants and animals that depend on large tracts of forested land, adversely affecting the long-term prospects of these populations. Converting forested land to other uses alters biodiversity by eliminating forest habitat, with remaining forest habitat reduced to small, widely separated patches.

Edge Effect

Edge is an ecological transition zone between two or more habitat types. In the context of forest fragmentation, edge is created where non-forest land abuts forest habitat. Edge conditions are often marked by a sharp contrast between forest habitat and adjoining non-forest land uses.

Edge effects extend beyond the physical edge of tree cover into the forest interior. Large contiguous blocks of forest tend to support more diverse fauna than smaller blocks because they can provide habitat for forest interior species. Interior species include black and white warblers, cerulean warblers, Acadian flycatchers, black-throated green warblers, and ovenbirds (Franzreb and Phillips, 1995). As the ratio of edge to interior habitat increases, habitat fragments can become small enough to exclude species that require large blocks of contiguous forest habitat. Habitat fragments smaller than a certain critical size are simply insufficient to support some species.

Edge effect in heavily fragmented forest landscapes has been documented to produce higher levels of disturbance, competition, predation, and nest parasitism than interior habitat (Muehler, 1997; Tilgham and Evans, 1986). These research results should be evaluated in the context of the conditions and locations studied. Studies on the effects of forest fragmentation on bird communities, documented in urban-agricultural dominated landscapes, may not be applicable to forest dominated landscapes (Petit et al., 1995).

Donovan et al. 1997 examined 75,000-acre study areas (hexagonal analysis areas 18 km. per side) in Illinois, Indiana, and Missouri. The amount of forest cover at the landscape scale included (1) highly fragmented (<15% forest cover), (2) moderately fragmented (45-55% forest cover), and (3) unfragmented (>90% forest cover) landscapes. They found that within-forest edge effects depend at least in part on landscape character. Nest predation by mammals tended to be greater in highly fragmented landscapes than in unfragmented landscapes. Avian predation patterns did not differ among landscapes, but differed between edge and core habitats. Hunter (pers. comm.) found the effects of predation and parasitism of within-forest habitat fragmentation to be of little impact to bird productivity where landscapes are less than 70 percent forested. According to the *Southern Forest Resource Assessment* Baker and Hunter (2002, p.94) that included the Cumberland Plateau and Mountains ecoregions, within-forest fragmentation was not a substantial problem in heavily forested areas, 70 percent or more forest.

Forest fragmentation and its associated effects (increased edge, reduced patch size, increased rates of predation, increased rates of nest parasitism) have been identified as a contributing factor in the decline of some songbird species, particularly that group referred to as Neotropical Migrants (Robbins, 1988; Robinson, 1997; Franzreb and Phillips, 1995). Neotropical migrant birds nest in spring and summer in North America and during the winter months they migrate to Mexico, the Caribbean, Central America, and South America. The Breeding Bird Survey data from 1966 to 1998 indicates that approximately 32 percent of this species group has exhibited significant ($p<0.1$) negative population trends over the period. In contrast, fourteen percent have exhibited significant ($p<0.1$) increases (USGS 2000).

Nest Parasitism

Nest parasitism is often cited as a potential reason for long-term population declines in a number of forest bird species, particularly forest interior species. The brown-headed cowbird, which frequents agricultural/residential landscapes and edge habitats, is undoubtedly North America's most widespread and best-known brood parasite. Rather than building its own nest and raising its own young, the brown headed cowbird lays its eggs in the nests of other birds and relies on those other birds, or hosts, to incubate and raise its young. Reproductive success in some host species can be markedly reduced as a result. Other host species may be able to make up reproductive success lost to parasitism (Muehler 1997; Whitehead et al. 2000). Parasitism rates tend to be low in grassland habitats, and many grassland species have developed behavioral adaptations against cowbird parasitism (Muehler 1997; Peer et al. 2000).

A study by Donovan et al. 1997 found that in unfragmented forest landscapes, cowbird abundance tends to be greater along edges. This may be because cowbird-feeding opportunities in such landscapes are limited, or because cowbird numbers are low and ample hosts exist close to the edges. There also may be energetic costs to penetrating deep into forest interior habitats.

Robinson et al. 1995 examined 10 kilometer-radius study sites in Illinois, Indiana, Minnesota, and Wisconsin. In heavily forested landscapes, they found cowbird populations might be limited more by foraging opportunities than by host availability. In more fragmented landscapes, on the other hand, the cowbird populations may be more limited by the availability of hosts and may saturate the available breeding habitat, resulting in high levels of parasitism even in the interior. Therefore, landscape level factors, such as percentage of forest cover, determine the magnitude of local factors, such as within-forest tract size and distance from the forest edges.

Forest Fragmentation in Kentucky

Significant numbers of humans have occupied this area for at least 1,000 years. Consequently, much of this landscape has been influenced by human activities for much of this time. Some plant and animal species have benefited from human-caused forest fragmentation, and others have not.

Contrary to a common misconception, Kentucky is gaining forest land. The forest land acreage within the Commonwealth of Kentucky increased by 253,300 acres from 1982 to 1997 (Figure 3 - 43). Most of the increase can be attributed to pastures reverting to woodland and to tree plantings. However, much farmland is also being converted to urban and other non-forest uses. Once this type of conversion occurs, the land is unlikely to revert to forest. The following land use changes occurred in Kentucky from 1982 to 1997 (NRCS 2000):

- Loss of 726,700 acres of cropland
- Loss of 273,900 acres of pastureland
- Loss of 291,200 acres of other land (Minor Uses)
- Gain of 253,300 acres of forest land
- Gain of 88,700 acres of federal land
- Gain of 595,600 acres of urban uses and roads

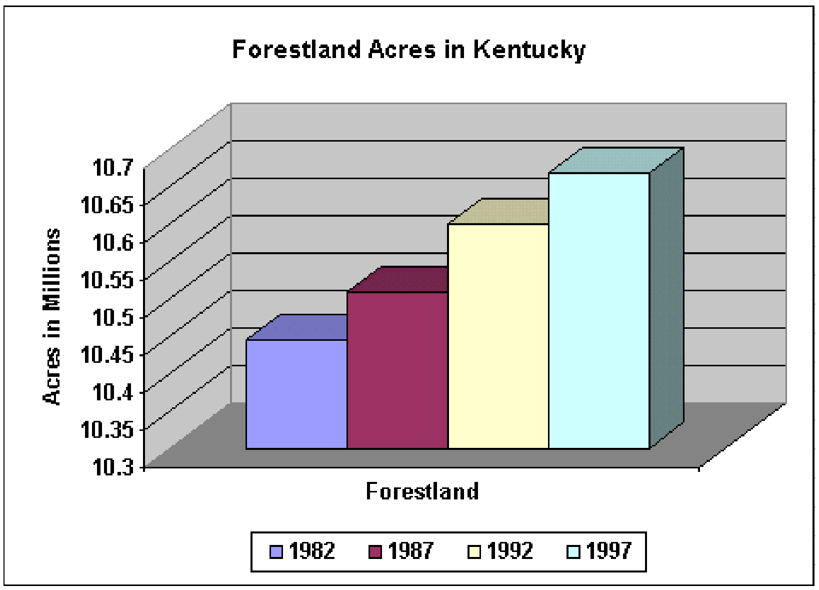

Figure 3 - 43. Forest land Acres In Kentucky.

The same increase in forest land appears to be true for the proclamation area of the Daniel Boone National Forest. When one compares aerial photographs taken of the Daniel Boone National Forest in 1939 to those taken in 2002 one finds that much of the farmland that was present in the early 1900s has grown up in forest.

The Daniel Boone National Forest is predominantly forest surrounded by forest. At this time, 34 percent of the land within the proclamation boundary is National Forest System land, distributed in a patchwork pattern over 21 counties. As of 2001, approximately 670,000 acres, or 98 percent of the land on the Forest was in a forested condition. Approximately 14,000 acres (2%) was in non-forest uses such as parking lots, administrative sites, and permitted uses such as water pumping stations, mineral developments, and major highways.

Within the proclamation boundary of the Forest, 95 percent of the land is in a forested condition (Table 3 - 67). Therefore, most private land surrounding the DBNF is forested. Satellite imagery indicates a slight land use trend toward forested conditions from 1978 to 1998.

Table 3 - 67. Forested and non-forested land use on the DBNF and the Northern Cumberland Plateau (National Land Cover Data Set, Commonwealth of Kentucky).

	DBNF				Northern Cumberland Plateau[2]	
	1978		1998		1998	
Land Use	Adjusted Acres[1]	Percent of Total Acres	Adjusted Acres	Percent of Total Acres	Acres	Percent of Total Acres
Forested	1,864,400	91%	1,959,654	95%	2,554,057	81.6%
Non-forest	178,074	9%	64,145	5%	577,280	18.4%
Total	2,042,474		2,042,474		3,131,337	

[1] Some inconsistencies in satellite imagery interpretation and applied land use categories exist between coverages. Acres have been adjusted to more accurately reflect known DBNF acreages.

[2] Northern Cumberland Plateau outside the DBNF Proclamation boundary in KY, SubSections 221Ha, 221Hb, 221Hc, 221He (USDA Forest Service, July 1994). Ecological Subregions of the U.S.: Section Descriptions. WO-WSA-5, p. 16-8 & 9.

On a broader scale, the Northern Cumberland Plateau ecoregion is somewhat less forested. About 612,624 acres (88.3%) of the Daniel Boone lies within this section. That portion of the Northern Cumberland Plateau outside of the Forest proclamation boundary, within Kentucky, is 81.6 percent forested. This indicates a potentially heightened degree of importance the Forest, and the immediate surrounding area, plays in sustaining species dependant on, or closely associated with, the eastern broadleaf forest of this physiographic region.

Further examination of land use, forest versus non-forest, was conducted using the National Land Cover Data Set (1998) to assess the potential interior forest land across the landscape (Table 3 - 68). A roving neighborhood analysis of 75,000-acre circular units (about six miles radius) was conducted within the proclamation boundary of the forest, providing an average value of interior conditions. For example: If half the cells in the 75,000 acre circular neighborhood are forest (value = 100) and half are non-forest (value = 0), the average value calculated for the center point will be 50, therefore a 50 percent interior forest value is assigned to that cell.

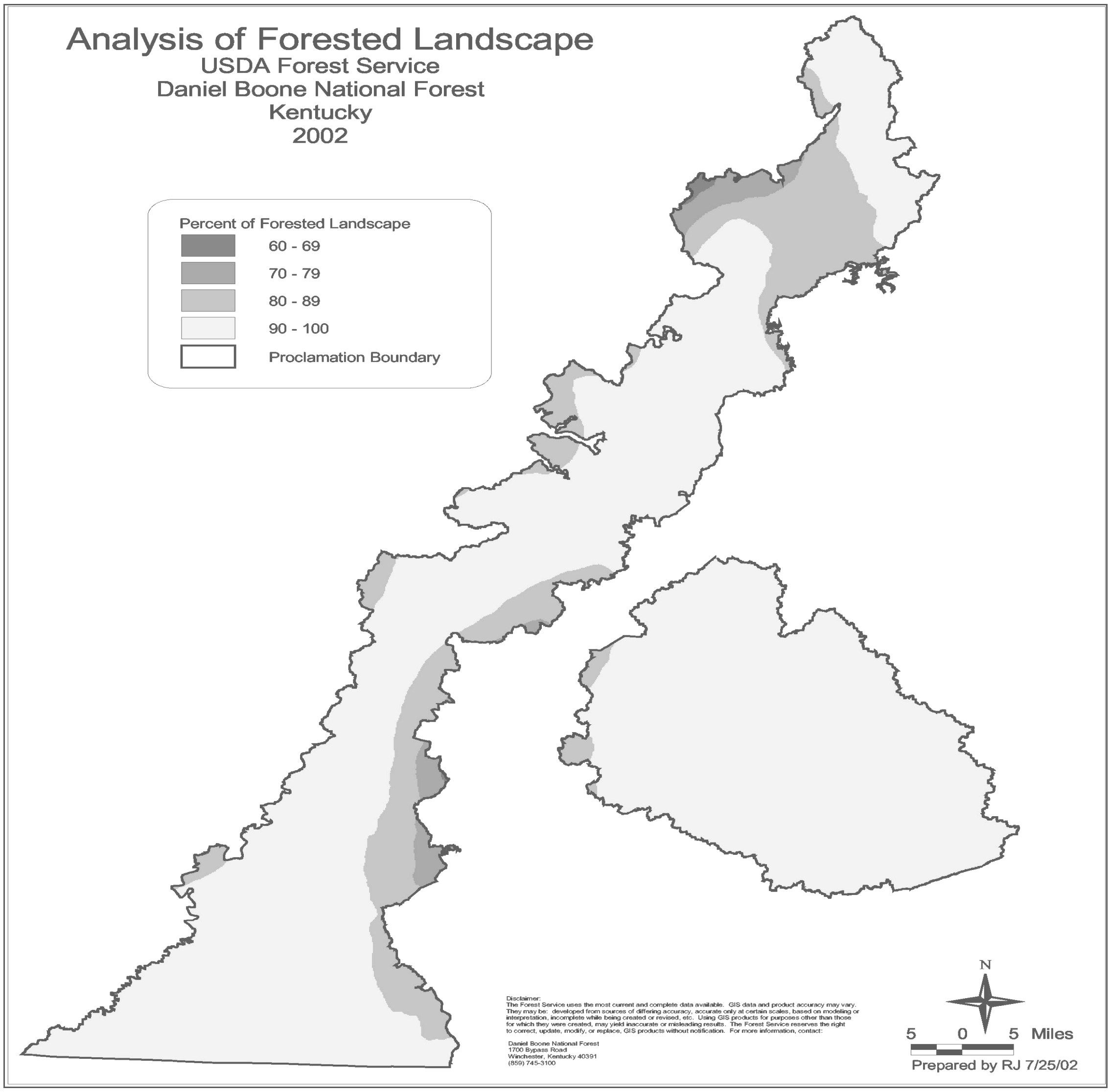

Figure 3 - 44. Analysis of the Forested Landscape.

Forest conditions dominate the landscape of the Daniel Boone (Figure 3 - 44). About 83 percent of the 75,000-acre analysis units are 90+ percent forested.

Table 3 - 68. Results of roving neighborhood analysis of forested habitat within the DBNF Proclamation Boundary using the 75,000-acre circular unit.

% OF FOREST COVER*	ACRES
60-69%	3,045
70-79%	42,974
80-89%	295,841
90-100%	1,700,503
Total	2,042,363

Percent of Forest Cover -- Calculated as the percentage of cells within the 75,000 circular units that are forested.

WITHIN-FOREST HABITAT FRAGMENTATION

In the context of forest management, within-forest habitat fragmentation is the interruption or isolation of forest habitat caused by changes in forest composition or communities, and/or changes in age-class conditions or seral stages. This is the primary facet of the fragmentation issue. The arrangement of tree species and age structure affects which plant and animal populations may be found in a forested area. This arrangement of forest habitat types across an area and the degree to which they are connected influences habitat suitability. An area where forest habitat types are small or not connected may limit suitability for some species. The implications of habitat fragmentation within the DBNF depend on habitat requirements for individual species. Many species thrive in a diverse mixture of habitats while others need more uniform habitats over a large area.

Habitat fragmentation within the forest is not a factor considered to be good or bad, but rather an element of species-specific habitat requirements. For example, a small wetland surrounded by hundreds of acres of dry ridge-top forest will greatly increase biodiversity in the forest. Likewise, a small patch of white pine surrounded by a large acreage of hardwood trees can provide roosting sites to many birds in inclement weather.

As with any activity that modifies habitat, results may favor some species while reducing suitability for others. Habitat modifications can be implemented to improve local conditions for rare or declining species, or they may be the result of natural disturbance, such as stand replacing fire or windstorm events. Forest ecosystems are dynamic and management has the opportunity to limit drastic changes that could potentially eliminate an entire suite of forest species or contribute to the demise of an already rare species.

Providing a highly diverse forest mosaic is essential to sustaining the wide variety of species found on the DBNF. Within-forest fragmentation is an integral part of developing and maintaining a biologically diverse forest. The continuum of natural communities on the DBNF ranges from open prairies to completely closed canopy cove forest. Woodlands, prairies, glades, and marshes are part of the mosaic of natural communities on the forest. Failure to conserve, maintain, preserve, and even to restore these communities will reduce biodiversity (USDA Forest Service, 1995). Projects planned to restore these ecosystems and provide habitat for the rare species that occupy them will fragment the surrounding forested habitat by opening up the canopy and causing discontinuity of the high canopy forest structure.

Taylor and Taylor (1979) identified 80 bird species associated with upland openings in northern forests. Pagen et al. (2000) illustrated the significance of early and mid-successional forest habitats as post-breeding habitat by some forest interior Neotropical migrant songbirds in Missouri. Rivera et al. (1998) observed similar behavior by post-fledging wood thrush in northern Virginia. They concluded that successful management of migratory species requires protection of habitat used during the post-fledging period as well as the breeding and nesting part of the life cycle.

Researchers have also documented the use of woodland openings by amphibians, reptiles and mammals (Adams et al., 1996; Campbell et al.; 1992; Pias et al., 1988). Burford and Lacki (1995) documented the use of openings as foraging habitat for the endangered Virginia big-eared bat. While they observed the highest percentage of use over old fields, they later found the majority of moth species consumed were dependent upon woody plant material for larval development (Burford and Lacki, 1998), demonstrating the importance of habitat diversity for this species.

Many factors have been identified as possibly contributing to the decline of Neotropical migrant songbirds. These factors include changes in land use on breeding grounds, losses of wintering habitat, reduction in migratory stopover habitat, climate change, pollution, and other factors such as the prevalence of domestic cats and collisions with towers and tall buildings (Robinson, 1997; Franzreb and Phillips, 1995).

As previously described, within-forest habitat fragmentation will not substantially limit the Forest's capability to sustain breeding populations of neotropical migrant birds and resident landbirds. However, habitat improvement opportunities may be considered to support population recruitment objectives for species that have demonstrated declines elsewhere in their range, such as the cerulean warbler (Plan Forestwide Objective 1.1.B.). Centers of abundance on the DBNF may provide source populations for areas of marginal habitat quality. Population sources are areas where reproductive success is high and a surplus of young are produced. Population sinks are areas with low reproductive success and the persistence of the population is dependent on immigration. This has important implications for the DBNF, suggesting that populations on individual forests are linked, and may even be dependent.

ANALYSIS AREA

For the purpose of assessing the effects of fragmentation on the forest, the area that affects the Alternatives or that is being affected by the Alternatives includes all lands within the proclamation boundary of the DBNF.

Environmental Effects

The primary elements of within-forest habitat fragmentation, considered in this analysis, are reduced interior forest habitat, habitat discontinuity, and high-density forest edge. These habitat conditions will change based on applied management activities. Resulting habitat suitability will be influenced by these changes, improving conditions for some species while reducing habitat quality for others. Species with requirements most closely associated with interior forest, habitat connectivity, and low-density forest edge will have the greatest potential to be affected.

Large tracts of older trees are believed to provide "interior habitat" for some species of birds and mammals. Within forest activities that break up tracts of mature forest may increase the amount of edge habitat relative to interior habitat.

Although forest edge may reduce habitat suitability for interior forest species it also adds habitat diversity. Edge habitat increases species richness and wildlife populations on a local level because the edge attracts wildlife species that use either type of habitat and those that use the transition between the two habitats (Meffe and Carroll, 1994; Tilghman and Evans, 1986).

Connectivity is the arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation (USDA Forest Service and USDI Bureau of Land Management, 1997). Forest habitat connectivity is an important consideration in providing for the movement of species in meeting seasonal needs, wide-ranging habitat requirements, genetic inter-change, and healthy population distributions. Connectivity is inversely related to fragmentation.

Many forest management activities affect the significance of these habitat elements as related to fragmentation. The following activities, Table 3 - 69, where identified as having high potential to substantially contribute to fragmenting effects and serve as a proxy to measuring within-forest habitat fragmentation. Direct measures of within-forest habitat fragmentation, such as patch size, habitat connectivity, and edge density, where not determined in this analysis.

RESOURCE TABLE

Table 3 - 69. Management parameters affecting within-forest habitat fragmentation.

MANAGEMENT PARAMETERS*	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Area Suitable for Timber Production** (% of NFS land)	68%	6%	50%	50%	50%	53%
Acres	470,294	36,822	347,714	347,714	347,714	370,490
0-10 Age Class per Decade (% of NFS land)	7%	1%	3%	3%	3%	5%
Acres	50,000	7,000	22,279	22,279	22,279	36,364
Shortleaf Pine Restoration (% of NFS land)	5%	5%	6%	6%	6%	5%
Acres	35,259	33,000	42,000	42,000	42,000	33,000
Woodland Habitat (% of NFS land)	0%	0%	9%	9%	9%	1%
Acres	0	3,562	58,700	58,700	58,700	3,562
Grassy Openings and Wooded Grassland/Shrubland (% of NFS land)	<1%	<1%	3%	3%	3%	<1%
Acres	2,171	3,100	20,450	20,450	20,450	3,100
Level of Riparian Habitat Discontinuity	Moderate	Low	Low	Low	Low	Low
Within-Forest Habitat Fragmentation	**High**	**Low**	**Moderate**	**Moderate**	**Moderate**	**High**

*Management Parameters - are based on long-term management objectives and Desired Future Conditions.

**Area Suitable for Timber Production – suitable timberlands are those on which most vegetation manipulation occurs.

The potential for introducing fragmenting effects within the DBNF are greatest where manipulation of the high canopy overstory is planned. Therefore, the portion of the Forest where treatments to maintain a diversity of age structure and composition are scheduled will indicate the potential scope of effects. These affects may be relatively long-lived and additive, as needed to maintain a cycle of forest regeneration. [Suitable area, 0-10 age class, Pine restoration]

Woodland habitat is characterized by a low basal area (30-50 sq.ft./ac.) forest condition with a well-developed shrub/grass/forb layer, promoted by a regular cycle of burning. This habitat will be found on upland sites, in hardwood (primarily oak), yellow pine, and mixed forest types (see 1.K. Habitat Diversity Emphasis Prescription-Forest Plan). Edge effects created by this community, in contrast to adjacent high canopy forest (70+ sq.ft./ac.), will be relatively minor even at lower woodland basal area densities. Crown development within woodland habitats will diminish potential disruption of the forest canopy. Understory development will greatly add to habitat diversity on the Forest, providing potential habitat for an entire suite of shrub nesting and foraging bird species. [Woodland habitat]

Wooded grassland/shrubland is characterized as a high canopy, low basal area (10-29 square feet/acre) forest with a well-developed shrub/grass/forb layer. This habitat condition consists of mid- to old-age (50-160 years) canopy trees with thin to dense low shrubs (≤3 ft) or grasses/forbs, which are promoted by a regular cycle of burning. It will be found within the oak-dominated and yellow pine-dominated forest types. The development and maintenance of this forest community type will add to within-forest habitat fragmentation. Edge created with adjoining forest will be prominent and high canopy forest structure will be interrupted for some species. Overall effects across the forest landscape should be minor, well within the historic range of variability.

Arguably this habitat type could be considered a non-forest land use, predominantly a grassland/shrubland community, adding to deforestation within the DBNF proclamation boundary. This habitat condition does not presently exist on the forest. To make this determination, a comprehensive inventory of species occurrence is needed to evaluate effects. There may also be very different habitat characteristics and species representation at each end of the range of prescribed tree density. For this analysis, wooded grassland/shrubland will be considered forested habitat. [Wooded grassland/shrubland]

Riparian habitat is well distributed across the DBNF in a somewhat linear pattern. Activities that interrupt the mature forest condition within this area will reduce capability to provide a corridor for species movement. It may also reduce opportunities to provide for interior species such as the Louisiana waterthrush and Acadian flycatcher. [Riparian habitat]

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Forest Fragmentation

Forest fragmentation affecting National Forest System lands is expected to change very little over the Plan period. Less than one percent additional land would be developed into new recreation areas or be cleared for road and utility corridors. Land acquisition can be expected to continue at about the same rate. Since 1990, the net increase in National Forest System land ownership has been 34,825 acres, an average of about 2,900 acres per year. Non-forest conditions on private in-holdings should be reduced to a small degree through acquisition and reforestation. No substantial difference in the direct and indirect effects on forest fragmentation would be expected between Alternatives.

CUMULATIVE EFFECTS

All Alternatives would influence forest fragmentation similarly. Within the first decade of the planning period, there could be a slight decrease in forested land within the proclamation boundary due to development on private land. Most of the development on private land will occur at the expense of agricultural land, due to existing road access and landform. Forest fragmentation should not substantially change on National Forest System land.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

Under this alternative the 1985 Plan would continue to be implemented, providing a relatively high level of within-forest habitat fragmentation across the Forest landscape. Regeneration harvest would be highest in Alternative A, covering seven percent of the Forest, introducing the greatest amount of regeneration edge. This fragmenting effect would persist through time until new forest stands again developed a high canopy forest character. Regeneration harvest activities would be distributed evenly over 68 percent of the Forest, lands suitable for timber production, potentially limiting options to provide interior forest habitat.

About five percent of the Forest would be restored to a pine-dominant community under this Alternative. Intensive site disruption would be necessary to re-establish pine, and prescribed burning would be necessary to maintain this fire mediated community. This would introduce forest edge conditions as well as fragmentation of mature forest habitat.

Alternative A also approaches riparian area management differently than any of the other Alternatives. Under current management, riparian habitat is regarded as suitable for timber production within specific filter strip and shade strip management provisions. This increases the potential for fragmentation of riparian habitat and reduces capability to link mature forest conditions.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

The overall emphasis of this Alternative would be custodial in nature with a minimum of direct human influence. It would result in the least amount of mature forest habitat fragmentation, as well as a more homogeneous age structure and composition across the DBNF. An abundance of interior forest habitat would be promoted. Plant and animal species associated with a relatively continuous uneven-aged forest would do well. Species associated with disturbance habitat types, including many high priority bird species, would be reduced, adding to the growing concern over declining population trends. Oak and pine ecosystems would be diminished to only where stochastic storm and fire events have produced canopy openings.

As the Forest ages, large areas would eventually undergo massive changes in composition resulting from insect and disease infestations, causing erratic population fluctuations and radical habitat fragmentation. There would also be an increased potential for the spread of insect and disease outbreaks to adjacent private lands with potential for radical habitat changes.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVES C, C-1, & D

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

These Alternatives would emphasize the maintenance of ecological processes and function while providing for multiple public benefits. About half of the Forest would be actively managed to provide a diversity of forest age-class structure. Planned activities within these Alternatives would result in a relatively moderate level of within-forest habitat fragmentation. Regeneration harvest activities would take place on about three percent for the DBNF, introducing a limited amount of regeneration edge. Large blocks of mature forest would be distributed across the planning area, supporting interior forest-dependent species.

About six percent of the Forest would be restored to a pine-dominant community under these Alternatives. Intensive site disruption would be necessary to re-establish pine, and prescribed burning would be necessary to maintain this fire-mediated community. This would introduce forest edge conditions and fragment some mature forest habitat.

The development and maintenance of woodland habitat in these Alternatives would introduce a component of edge, though to minor degree, since resulting habitat differences are less pronounced. Open forest conditions would provide for species associated with a prominent shrub layer as well as promote full crown development.

Development and maintenance of the wooded grassland/shrubland habitat type planned in these Alternatives would add to within-forest habitat fragmentation. Species richness on the forest would be improved, however, expanding opportunities for grassland-associated species such as the field sparrow, Henslow's sparrow, and bobwhite quail.

Retention of riparian habitat, as provided in the Riparian Corridor Prescription, would provide an element of connectivity for high canopy forest structure across the DBNF.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

With its management emphasis on production of goods and services, this Alternative would generate a relatively high level of within-forest habitat fragmentation. Slightly over half of the Forest would be actively managed for timber products. Timber harvest would be concentrated in coves and on lower slopes where site quality is highest. Dry ridge tops would not be managed intensively. Differences would appear as the uplands develop into mature forests and the lower slopes into a variety of forest conditions. Future decades could see a reduction in oak dominance on ridge tops as the already mature trees die and are replaced by shade tolerant species such as red maple. Harvest and increased road building would disrupt habitat continuity and limit options for interior forest habitat.

About five percent of the Forest would be restored to a pine-dominant community under Alternative E-1. Intensive site disruption would be necessary to re-establish pine, and prescribed burning would be needed to maintain this fire-mediated community. This would introduce forest edge conditions and fragment some mature forest habitat.

Retention of riparian habitat, as provided in the Riparian Corridor Prescription Area, would lend some degree of connectivity to the high-canopy mature forest structure across the forest.

CUMULATIVE EFFECTS

None beyond those already described.

OTHER EFFECTS

Forest fragmentation resulting from changes to non-forest land-uses that are beyond the control of the Forest Service, e.g., highway development, private minerals extraction, and urban development and associated utility corridors, would occur.

The potential for the increased spread of non-native invasive species and their fragmenting effect on native populations would remain.

Resource Programs

RECREATION

Affected Environment

Introduction

Daniel Boone National Forest Market Area

The Daniel Boone National Forest is characterized by an outstanding variety of land features such as artificial lakes, mountains, rivers and streams, arches, cliffs, caves, a wide variety of vegetative types, and outstanding scenery that enhances and supports heavy recreational use. Because of its location along major roads such as Interstate 75, Interstate 64, the Cumberland Parkway, and the Daniel Boone Parkway, the Forest is readily accessible to people in Tennessee, Ohio, West Virginia, Indiana, and Illinois.

The recreation market has two segments:

- Local users in close proximity to the Forest. Most of these are from a predominantly rural or small town environment. In some cases local users include people from larger cities such as Lexington, Covington, and Ashland, Kentucky.
- Users from surrounding, more highly populated, areas less than one-half day's travel or one tank of gasoline away. This user segment stretches east to Charleston, West Virginia, south to Knoxville, Tennessee, north to Cincinnati and Columbus, Ohio, and west to Louisville, Kentucky, and Nashville, Tennessee.

Within the Daniel Boone National Forest market area the following recreation areas compete for recreation visitors:

National Areas: Big South Fork River and Recreation Area, Cumberland Gap National Historical Park, and Mammoth Cave National Park.

Large Lakes: Cave Run Lake, Laurel River Lake, Cumberland Lake, Dale Hollow Lake, Herrington Lake, Green River Lake, Grayson Lake, Dewey Lake, Buckhorn Lake, Fishtrap Lake, Kincaid Lake, and Paintsville Lake in Kentucky; Douglas Lake, Cherokee Lake, and Norris Lake, in Tennessee; Caesar Creek Lake, East Fork Lake, Rocky Fork Lake, and Paint Creek Lake in Ohio; Beach Fork Lake and E. Lynn Lake in West Virginia.

State Parks: Lake Cumberland State Resort Park, General Burnside State Park, Dale Hollow Lake State Park, Green River Lake State Park, Grayson Lake State Park, Greenbo Lake State Resort Park, Jenny Wiley State Resort Park, Buckhorn Lake State Resort Park, Kincaid Lake State park, Barren River Lake State Resort Park, Cumberland Falls State Resort Park, Levi Jackson State Park, Pine Mountain State Resort Park, Natural Bridge State Resort Park, Kentucky Horse Park, Fort Boonesborough State Park, General Butler State Resort Park, Blue Licks Battlefield State Park, Big Bone Lick State Park, Carter Caves Resort State Park, My Old Kentucky Home State Park, and Carr Creek State Park, in Kentucky; Douglas Lake, Cherokee Lake, and Norris Lake, in Tennessee; Caesar Creek Lake, East Fork Lake, Rocky Fork Lake, and Paint Creek Lake in Ohio; Beach Fork Lake and E. Lynn Lake in West Virginia.

Recreation use trends

Several social and demographic characteristics affect outdoor recreation demand. These factors affect the type of recreation opportunities selected and time during the year or week that recreation activity will occur.

Some changing social characteristics (Cordell 1990):

- An aging population with earlier retirements
- Decline in available leisure time
- Increase in immigration
- A more ethnically diverse population
- More dual income families
- More single parent families
- Fewer extended families
- People marrying and having children later in life.

These changing social characteristics are having the following effect on leisure activities:

- Total hours of use in federal recreation areas have remained constant or increased slightly over the past 10 years, but the total number of visits has increased.
- The number of 2- or 3-week vacations is declining, but the number of day trips or long weekend trips is increasing.
- The percentage of all trips to national forests that required two hours or less in travel time increased from 43 percent in 1977 to 72 percent in 1986.
- The number of trips of greater than eight hours travel time dropped sharply from 23 percent in 1977 to six percent of all trips in 1986 for national forests; for national parks this number dropped from 41 percent in 1977 to 9 percent in 1986.
- The proportion of visits that are one day (24 hours) or less is increasing while the number of visits longer than one day is declining.

The 1993 update to the RPA Assessment of the Forest and Rangeland Situation in the United States (Report 27) considered the above changes and identified some shifts in recreation demand (USDA Forest Service 1994b).

- The total number of people participating in recreation is expected to increase across all recreational activities during the next five decades.
- The percentage of the total population participating in recreation has stabilized in recent years, as has the per capita allocation of leisure time to recreational pursuits.
- Total demand for recreation should keep in line with population growth if this pattern continues in the future.
- In addition, real per capita income is projected to more than double by 2040. This extra income will contribute to differing rates of growth in various recreation activities. For example, demands for snow-related recreation are expected to grow at a faster rate than for

most land- and water-based activities, but the latter activities will continue to dominate total recreation patterns.

- If public and private sector providers continue to expand opportunities at rates in line with recent trends, projected increases in supplies should meet most of the projected increases in demands.
- Closure of private land to *free* public access does not necessarily mean that the land is lost for recreation opportunities.
- Most of the increased demand will occur near existing population centers.
- National forests and other public lands in the north, south, and Pacific coast regions are expected to become relatively more important for all forms of recreation if access remains generally unrestricted and free.
- Wilderness use accounts for less than one percent of all outdoor recreation. Total time spent in wilderness areas has been relatively stable in recent years.

Recreation demand continues to focus on peak periods such as weekends and holidays. The ability of the private sector to provide support services and facilities may be constrained by the reduced demand of non-peak periods. This will affect the overall recreation experience and influence demands placed on the Forest.

Recreation Supply

The Daniel Boone National Forest is one of the major providers of outdoor recreational opportunities for Kentucky, southern Ohio, West Virginia, and southeastern Indiana. Particularly important is the Forest's ability to offer the public large, unbroken tracts of forested land for recreational activities such as scenic viewing, long-distance trail use, wilderness exploration, and hunting. Classified as an "urban" forest because of its proximity to several metropolitan areas, most of the Forest's approximately 700,000 acres is available to the public for a variety of outdoor recreational pursuits. These opportunities, which generate added tourism for some neighboring communities, can be divided into two broad categories:

- Developed recreation, which offers areas with constructed facilities providing public amenities and conveniences.
- Dispersed recreation, which features primitive settings, isolation, challenge, and risk.

Developed recreational opportunities can be found at campgrounds, picnic areas, boat ramps, marinas, and interpretive sites. Trail use, rock climbing, lake and river boating, hunting and fishing in undeveloped forest settings comprise most of the dispersed-use opportunities. In both developed and dispersed recreation experiences, interpretive and environmental education activities and facilities provide an opportunity for visitors to learn more about the natural environment and the Forest Service's role in managing it.

Over the years, use-levels have been a primary basis for analyzing and evaluating Forest Service recreation program needs. In past years, use was calculated in "recreation visitor-days" (RVDs). Because this method proved statistically inaccurate, Congress has funded new statistical recreational surveys for national forests across the country. However, the new use survey and report for the

DBNF was not expected until 2003. Therefore, information on recreational use of the Forest for this Draft Environmental Statement was obtained from other readily available sources such as:

- Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends (Cordell et al. 1999), a national study that responds to direction from the Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974
- Daniel Boone National Forest field observations of use trends over time
- Information gathered from occupancy data at fee sites
- Changes in observed parking use at trailheads
- Forest Service personnel's contacts with the public.

This type of information, along with Kentucky's Statewide Comprehensive Outdoor Recreation Plan data (SCORP), was used to analyze and predict the Forest's recreation program demands and trends. Details of use information, along with estimated RVD formulas and assumptions, can be found in the DBNF's Analysis of the Management Situation (USDA Forest Service 1997).

A recreation program can also be analyzed according to the types of recreation experiences available. The Recreation Opportunity Spectrum (ROS) categorizes recreational settings by physical, biological, and managerial characteristics as well as by access and facility type. The differing acreage available for the various ROS experiences can be used to compare the proposed alternatives for the 2004 Forest Plan.

Five ROS experiences can be found on the DBNF. They range from those that provide visitors with opportunities for solitude in an environment with limited evidence of human impacts to intensely social settings in highly developed environments. These ROS experiences include:

Semi-Primitive Non-Motorized: Predominantly natural environment with minimum evidence of human activity. High probability of isolation from sights and sounds of humans. Motorized use is prohibited.

Semi-Primitive Motorized: Predominantly naturally appearing environment with some evidence of human activity. Concentration of users is low. Motorized use is allowed.

Roaded Natural: Predominantly natural appearing environment with moderate evidence of human activity; moderate probability of experiencing affiliation with others. Motorized use is allowed.

Rural: Substantially modified natural environment. Probability for experiencing affiliation with others is prevalent, as is the convenience of sites and opportunities. Motorized use is allowed.

Urban: Substantially developed environment dominated by man-made structures. Sites and sounds of humans are predominant. Probability of experiencing others is prevalent, as is a higher level of convenience of sites and opportunities than in Rural ROS experiences. Motorized use is provided for.

The Forest Service also includes a Primitive category in its national ROS model. This category requires largely unmodified tracts of land 5,000 acres or larger and at least three miles from roads or motorized trails. No lands on the DBNF meet those criteria. However, management of the wilderness areas and wild rivers on the DBNF currently follows the Primitive ROS model. This could change after the Limits of Acceptable Change process is completed.

Recreation Residences

Recreation residences were established in the very early days of the Forest Service. Some of the residences pre-date the designation of the National Forests. These are privately owned cabins under National Forest special use permits. The addition of new recreation residences was terminated in 1968. Currently, this Forest has 13 residences found along one road on the London District. If permits are not renewed the residence is removed and not replaced.

Developed Recreation

The DBNF provides a full range of developed recreation sites with a combined capacity of 15,830 people-at-one-time (PAOTs) (Table 3 - 70). These sites include campgrounds, picnic areas, swimming beaches, fishing sites, interpretive sites, boat launching ramps, and shooting ranges. The majority of the Forest's developed recreation facilities, and heaviest use, is concentrated around Cave Run and Laurel River Lakes. These lakes have modern recreation facilities such as campgrounds with municipal water, sewer plants, flush toilets, hot showers, and recreational vehicle hook ups; paved, two-lane boat ramps, private marinas under special use authorization from the Forest Service, and picnic areas with paved parking and toilets. Tourism centered on these lakes contributes significantly to the local economy of these areas.

The level of development and amenities provided at recreation facilities can be divided into five categories. "Developed" recreation sites fall into Levels 2 through 5 while "undeveloped" sites are classified as Level 1. These classifications are described below:

> **Level 1:** Undeveloped recreation sites. Rustic, rudimentary improvements only for the protection of the site rather than the comfort of the user. Little active management occurs. Motorized access not permitted or provided. Found in Primitive or Semi-primitive ROS experiences.
>
> **Level 2:** Minor site modification; mostly rustic and native materials; primitive motorized access. Found in Semi-primitive ROS experiences.
>
> **Level 3:** Moderate site modification, some for public convenience; synthetic materials used; motorized access by higher standard roads. Found in Roaded Natural ROS experiences.
>
> **Level 4:** Heavier site modification, many amenities for public convenience; synthetic materials are common; motorized access by high standard roads. Found in Roaded Natural ROS experiences.
>
> **Level 5:** High degree of site modification, many amenities and some luxury facilities for public convenience, landscaping may be formal with some non-native plants, formal paved walkways in addition to highway access. Found in Rural or Urban ROS experiences.

PAOTs by development level were used to compare the developed recreation program by alternative.

Table 3 - 70. Summary of major developed recreation facilities by development level and capacity.

TYPE OF SITE	Development Level[1]	Number of Sites	Capacity (PAOT[2])	Number of USFS Fee Sites	Number of Concession Fee Sites
Campgrounds	4/5	6	6,201		5
Campgrounds	3	11	1,550	1	5
Campgrounds	2	4	75		
Picnic areas	3/4	17	1,705	1	2
Fishing	3	4	190		
Boat ramps	2/3	20	1,865	11	
Boat ramps	4/5	6	1,930	3	
Shooting ranges	3	4	75	2	1
Horse camps	3	3	305	1	1
Private marinas	5	5	N/A		
Visitor centers	4/5	2	55		

[1]Development Level codes: Level 2 = Minor site modification; Level 3 = Moderate site modification; Level 4 = Heavier site modification; Level 5 = High degree of site modification.

[2]PAOT = Persons-at-one-time

Developed recreation facilities provide a "home base" for the public, many of whom travel up to 150 miles, to explore the Forest and enjoy dispersed recreational opportunities such as camping, boating, fishing, hunting, wildlife viewing, and hiking.

The Forest also provides more primitive, smaller campgrounds and picnic areas that are used primarily by local residents and their families. The relative lack of easy access from major highways, long distances from population centers, and no major natural features make these areas desirable to local residents but do not draw many distant visitors.

The number and size of the Forest's developed facilities have changed little in the 30 years since the Cave Run Lake and Laurel River Lake facilities were built. Most other recreation facilities were built 40 or more years ago. There have been improvements made to the facilities that provide the higher levels of amenities increasingly desired by the recreating public.

Forest Service efforts to improve these facilities appear successful. The public has indicated in various surveys that the DBNF provides generally "good" quality recreation at the major recreation sites (Vogel 2000; Slone 1997; Payne et al. 1994; Marriott 1992).

Based on observations and camping data from the Forest, the amount of use at developed sites has not changed significantly in the last 10 years. However, patterns and types of use have changed. Demand for tent camping with few amenities at developed sites has declined while demand for recreational vehicle hook ups and tent camping at sites with more amenities, such as hot showers, has increased. Demand for single family picnicking at sites with no other activities available has declined while demand for group picnicking (e. g., reunions, businesses, churches, clubs) at facilities providing a variety of additional activities has increased.

Dispersed Recreation

Dispersed recreation use has increased over the past two decades. This increased use follows the nation-wide trend (Cordell 1999). Unlike the stable number of developed recreation sites on the Forest, the DBNF has increased its dispersed recreation program in the past two decades to meet these increasing and changing demands. For instance, almost 100 miles of trails have been added to the Forest since the 1985 Plan took effect. At the same time, the DBNF has placed more restrictions on off-trail activities. Most Forest trails were designed in the 1970s, primarily for hiking, but off-highway vehicles (OHVs) and horses were also allowed on these trails. During the 1980s, however, the Forest saw a dramatic increase in OHV, mountain bike, and equestrian traffic, both on and off trails. The resulting user conflicts and resource impacts prompted the Forest to amend the 1985 Plan in 1998, permitting OHV use only on designated trails constructed to better accommodate such use.

Many of the environmental impacts from dispersed recreation are generated by recreational trails, i.e., hiking, mountain biking, horse, and OHV trails. Trail use is also one of the major dispersed recreational activities found on the Forest. The opportunities offered in each alternative for this type of dispersed use is one of the major recreation differences between alternatives, and thus miles and types of trails are indicators used to compare them. A few other types of dispersed recreation have also caused impacts on a localized basis. Rock climbing, which has not been addressed on a Forestwide basis, requires attention.

The Red River Gorge Geological Area (RRGGA) continues to experience increasingly heavy use and resource impacts. This changing use and the resulting impacts are a concern for this area, which is renown for its unique archeological and biological resources. As recreation use and crowding has increased, so has public exploration into remote areas of the RRGGA that had previously seen little use. Clifflines and rock shelters are particularly popular with visitors. Historically, these areas were frequently used by Native Americans and thus contain important archeological information. Recently, heavy use by campers has damaged or destroyed many important heritage resources as well as some unique biological resources. To protect these, camping in rock shelters and near the base of clifflines has been restricted. Clifflines in the RRGGA are also known internationally for their superior rock climbing experiences. The growing popularity of this activity nationwide has been reflected in a significant increase in rock climbing in the Gorge. Over the past five years, rock climbing has moved from an incidental recreational use to a major activity. This increased use has required much closer management to protect sensitive heritage and biological resources as well as quality rock climbing experiences.

Boating use on Cave Run Lake and Laurel River Lake has increased to the extent that some recreationists and Forest Service managers have expressed concerns about crowding and user conflicts. While there is some perceived over-crowding, perhaps exacerbated by boating conflicts (primarily with personal watercraft), survey responses from boaters did not register over-crowding as a widespread concern (Vogel 2000; Slone 1997; Payne et al. 1994). Regardless of opinions about lake congestion, demand for boating slips at the lakes’ marinas continues to exceed supply.

The Forest continues to be a popular place for hunters, anglers, and wildlife viewers. Wildlife viewing and recreational fishing appears to be holding steady and present few management challenges while hunting near private residences adjacent to National Forest land has caused some problems.

Environmental Effects

For the purposes of assessing the direct and indirect effects to recreation by the various alternatives, only National Forest System lands of the DBNF were considered. Cumulative effects, however, are assessed on both National Forest System lands and private land adjacent to the Forest.

RESOURCE TABLES

How the various alternatives would differ from the current situation in both number and percentage of acres for each ROS experience can be seen in Table 3 - 71.

Table 3 - 71. Estimated percentage of Recreation Opportunity Spectrum (ROS) setting, in acres and percent of DBNF, by alternative.

ROS Category	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Primitive *	19,564	22,398	19,564	19,564	19,564	19,564
Semi-Primitive Non-Motorized	20,811	105,897	20,811	20,811	35,186	13,875
	3%	15%	3%	3%	5%	2%
Semi-Primitive Motorized	13,875	385,550	13,875	13,875	70,373	13,875
	2%	55%	2%	2%	10%	2%
Roaded Natural	617,331	174,932	617,331	617,331	546,108	610,280
	89%	25%	89%	89%	78%	88%
Rural	41,623	27,749	41,623	41,623	41,623	55,498
	6%	4%	6%	6%	6%	8%
Urban	88	88	88	88	138	200
	< 1%	<1%	<1%	<1%	<1%	<1%

*Social and managerial settings are managed for primitive in Wilderness and Wild Rivers until the limits of acceptable change process has been completed. No areas on the DBNF meet the current definition of Primitive ROS. Thus, these acres are also included in other ROS categories, and no percentage is shown.

Table 3 - 72 summarizes of the differences between alternatives in recreation site capacity (PAOT) by the development level of these sites.

Table 3 - 72. Estimated developed recreation offered in PAOTs (persons-at-one-time) by facility development level and alternative

Development Level	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
2	990	600	900	900	900	500
3	6,924	6,700	6,700	6,900	6,900	6,200
4	940	900	900	975	975	900
5	6,976	6,976	7,400	7,400	7,800	8,300
Totals	15,830	15,176	15,900	16,175	16,575	15,900

Table 3 - 73 compares by alternative the expected total number of trail miles that would be available to the public. Estimated miles of permanent trail closures are factored into the totals. Closures would be done to provide a better recreation experience for most riders or protect the ecosystem.

Table 3 - 73. Estimated total number of miles of trails offered by alternative.

TRAIL TYPE	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
OHV only	22	0	22	65	85	85
All others*	590 (OHVs allowed on 126 miles)	560 (No OHVs allowed)	590 (OHVs allowed on 108 miles)	620 (OHVs allowed on 108 miles)	640 (OHVs allowed on 118 miles)	640 (OHVs allowed on 118 miles)
Total	612	560	612	685	725	725

*Includes trails where hiking, mountain bike and horse use are allowed singly or in combination with each other. It also includes trails where OHV use is allowed in combination with other trail uses.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT AFFECTS

There are no direct or indirect effects common to all alternatives.

CUMULATIVE EFFECTS

Private development adjacent to National Forest System land would affect recreational experiences in the affected interface. Persons desiring to get away from human influence and experience more solitude on National Forest System lands would avoid such areas.

The increasing private development adjacent to National Forest System land could lead to more illegal activities such as OHV use off of designated trails.

Restrictions could be placed on some types of recreational activities if they increased the likelihood of spreading invasive species onto or throughout National Forest System lands.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Recreation in General: Just as this alternative would continue the current level and density of developed recreation sites, trails, roads, and other management activities (particularly wildlife development, minerals extraction, and timber management), the distribution of recreation settings and experiences that now exists on the Forest would remain. Social and managerial settings in Wilderness and Wild Rivers would be managed according to the Primitive ROS model until the Limits of Acceptable Change process was complete. No areas on the DBNF can be classified as ROS Primitive as it is currently defined. Thus, approximately five percent of the lands would fall into the Semi-primitive Motorized and Non-motorized ROS categories. These lie primarily within designated Wilderness areas or Wild and Scenic River corridors. Most of the DBNF -- 95 percent -- is classified as ROS Roaded Natural or Rural. That is reflected in the level of management activities and facility development most commonly found across the Forest. Urban ROS, highly developed settings, is found on less than one percent of the Forest. These areas are found primarily at the most highly developed recreation areas such as Twin Knobs and Holly Bay Campgrounds.

Environmental interpretation and education activities would remain at the same levels and locations.

Developed Recreation: The Forest's developed recreation facilities would be retained and continue their past schedules. The current capacity is 15,830 PAOTs. Eighty-eight percent of these PAOTs are concentrated in several Level 3 developed areas and a few, large Level 5 developed recreation areas. Minor changes in capacity and existing facility upgrades would continue, helping to accommodate public demand for more modern amenities. A few closures might take place at low-use sites that are uneconomical and are not needed to meet public demand. Efforts toward the development of a resort at the Caney site on Cave Run Lake would continue.

Dispersed Recreation: The miles and types of trails offered to the public for Forest access would remain similar to what now exists. Currently, this includes 612 total miles of trails, 126 miles of which are open to OHV use. Illegal OHV trail use could be expected to continue at current levels, as would the Forest Service's ability to enforce OHV closures.

The recreational use in the RRGGA by rock climbers and campers would continue to be managed, primarily through site closures, to protect heritage and biological resources. However, little progress would be made in providing the management required to make more sites available for these increasingly popular activities.

The potential for crowding on Cave Run Lake and Laurel River Lake would still be watched carefully by managers while public demand for more boat storage at the lake would continue to exceed the existing facilities.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Recreation in General: This alternative would favor more rustic and primitive settings and experiences. There would be less road and trail development and much less access needed for timber and wildlife management activities. Emphasis would shift from Roaded Natural ROS experiences toward Semi-primitive. However, Rural and Urban ROS experiences normally associated with highly developed and well-accessed recreational sites and development on private lands would change little. The cost of removing heavily used, higher-level developments and their associated higher-level roads is usually prohibitive. Semi-primitive settings would move from the current five percent of the Forest to 70 percent as large acreages were taken out of the Roaded Natural ROS experience. While Rural and Urban settings would change very little, they would decrease from seven to five percent of the Forest.

Designation of the Wolfpen Inventoried Roadless Area as a Wilderness Study Area would have little effect on recreation within Wolfpen itself since most activity there is already Non-motorized Dispersed recreation. It would, however, preclude new rock climbing routes that use fixed anchors since anchors are not allowed in a Wilderness area. Most existing fixed anchor routes would remain.

Interpretation and environmental education would continue to be emphasized but in more venues that would not involve developed facilities.

Developed Recreation: Uneconomical, low-use sites would be closed. Portions of recreation sites not adequately meeting public needs and not easily or economically brought up to standards to meet those needs also would be closed. There would be no expansion of existing facilities, just basic maintenance and operation. Some recreation sites might not be kept open for as long a season. Resort development at Cave Run Lake would be inconsistent with this alternative.

These changes would cause an appreciable decrease in the offered developed recreation opportunities in the development Level 2 and 3 facilities.

Dispersed Recreation: The overall miles of trails available for use would decline from 612 to 560. Some low-use trails would be closed, as would some trails now open to off-highway vehicles (OHVs). Restrictions would be placed on additions to the trail system. Alternative B-1 would also eliminate all OHV use on trails and somewhat diminish horse-riding opportunities when there are both fewer options for such opportunities and growing public demand. Illegal OHV use would probably increase due to a lack of trails designated for such use and the Forest Service's decreased ability to access more areas and enforce closures.

This alternative would have little impact on dispersed activities in the Red River Gorge Geological Area. Forestwide, there would be little change in non-trail recreation activities.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

Recreation in General: There would be little change in the recreation program from what currently exists. While some recreation facilities and trails might be added, others could be eliminated to improve economic efficiency or quality in addition to limiting ecosystem impacts. Recreation sites, because of their small size in relation to all National Forest System land, have only a nominal impact on total ROS distribution. Specially designated areas, such as Wilderness areas, the Red River Gorge Geological Area, and the Wild and Scenic Rivers, comprise the greater portion of the Forest's Semi-primitive settings, and those would not change regardless of alternative. Trails have only a nominal impact on a localized area as well as total ROS distribution. Wilderness and Wild Rivers management would follow the ROS Primitive model until the Limits of Acceptable Change process was complete. No areas on the DBNF qualify as ROS primitive as currently defined, however. Thus, approximately five percent of National Forest System land would remain in the Semi-primitive Motorized and Non-motorized ROS categories. Roaded Natural and Rural ROS experiences would continue to be found on 95 percent of the Forest. Urban ROS, highly developed settings, would still be found on less than one percent of the Forest.

Emphasis in other resource areas would shift away from the 1985 Plan toward more non-commodity management. The distribution and intensity of management of these resource areas would also differ from the current situation. While these differences could cause adjustments in recreation use patterns, they would be minimal. Interpretation and environmental education would remain at the same sites and levels where they currently exist.

Developed Recreation: The recreation emphasis of this alternative would be similar to Alternative A. The current capacity of the Forest's developed recreation facilities would continue to be provided for and would remain open for similar periods. Capacity would remain near 15,900 PAOTs. Ninety percent of these PAOTs would be concentrated in numerous Level 3 developed areas and a few, large development Level 5 recreation areas. Minor changes in capacity and existing facility upgrades would continue, helping to accommodate public demand for more modern amenities. A few low-use sites that are uneconomical or are not needed to meet public demand could be closed.

Efforts toward the development of a resort at the Caney site on Cave Run Lake would continue.

Dispersed Recreation: The effects of this alternative would be similar to Alternative A, except for restrictions placed on some activities, e.g., overnight camping in ecologically sensitive locations such as the Riparian Corridor and the Cliffline Community Prescription Areas. There would still be 612 total miles of trails available, but OHV trails would be consolidated through closure of some short trails and additions that would create longer loop-trail systems. OHV trails would total about 108 miles, 18 miles less than currently exists.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

Recreation in General: There would be some increased emphasis on the recreation program, including the development of recreation areas, roads, and trails compared to Alternative C. Ecosystem protection would continue to be a major consideration, however. Other resource management changes would be similar to Alternative C, with similar affects on the recreation program. Thus, while there could be minor differences in where various ROS experiences occur and some differences in recreation development within recreational sites in various existing ROS experiences, the overall distribution of these settings would not change appreciably from the current situation. Wilderness and Wild Rivers management would follow the ROS Primitive model until the Limits of Acceptable Change process was complete. No areas on the DBNF qualify as ROS primitive as currently defined, however. Approximately five percent of National Forest System lands would continue to remain in Semi-primitive ROS experiences comprised mostly of designated Wilderness areas and Wild and Scenic River corridors. Road Natural and Rural ROS experiences would make up the remaining 95 percent of the Forest with the Urban category still constituting less than one percent.

Interpretation and environmental education would be similar to Alternative C, but with a few new facilities and improvements to existing facilities.

Developed Recreation: Alternative C-1, while similar to Alternative C, would provide for the improvement or upgrading of certain facilities where public need has been demonstrated. For example, there would be expansion or improvements at existing horse camps, continued efforts to develop the Caney site resort at Cave Run Lake, addition of Level 2 campsites in the Red River Gorge, and additional group use facilities at existing sites. This alternative would also provide for upgrading of facilities such as additional RV hook-ups, modern toilets, improved lighting, and accessible features for the disabled, and more boat docks. To help accomplish these goals and remain within budget, some low-use, uneconomical sites could be closed. Overall, there would be a slight increase in the number of PAOTs offered compared to Alternative C (15,900 vs.16,175). This increase would come primarily from an increase in Level 3 developed facilities.

Dispersed Recreation: To improve public service and better protect the ecosystem, off-highway vehicle (OHV) trails less than 15 miles long would be considered for closure, along with a few other trails. Lack of adequate OHV and horse trails would be addressed by considering the addition of about 20 miles of OHV trails to the current OHV trail systems and construction of a new 30-40 mile OHV trail system. Where possible, current OHV trails would also be connected to provide for longer continuous trails. For horseback riders, an additional 20 miles of trail systems served by horse camps would be considered. An effort would be made to connect DBNF horse trails to those in the Big South Fork National Recreation Area. An overall increase in the Forest’s total trail mileage, from 612 miles to 685 miles, would come from non-motorized trail additions. The total OHV trail miles would increase from what currently exists. The effects of this alternative would be similar to Alternative C, with the exception of some additions of trail mileage and restrictions placed on some activities, e.g., overnight camping in ecologically sensitive locations such as the Riparian Corridor and the Cliffline Community Prescription Areas. Also, some rock shelters in the Red River Gorge Geological Area (RRGGA) might be designated for camping, and additional efforts would be made to locate rock-climbing opportunities both inside and outside of the RRGGA.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

Recreation in General: Increased development of recreation areas, roads, and trails with an overall increase in recreation development would be emphasized with less consideration for ecosystem impacts. Other resource management changes would be similar to Alternative C-1, with similar affects on the recreation program. Thus, while there may be minor differences in where various ROS experiences occur and some differences in recreation development within recreational sites in various existing ROS experiences, the overall distribution of these settings would not change appreciably from the current situation. Wilderness and Wild Rivers management would follow the ROS Primitive model until the Limits of Acceptable Change process was complete. No areas on the DBNF qualify as ROS primitive as currently defined, however. Approximately five percent of the lands would continue to remain in the semi-primitive ROS categories, comprised primarily of designated Wilderness areas and Wild and Scenic River corridors. Road Natural and Rural ROS categories would make up the remaining 95 percent of the Forest with the Urban category still less than one percent of the Forest.

Interpretation and environmental education would increase with the addition of new programs and facilities, and improved facilities at existing sites.

Developed Recreation: Developed recreation facilities would be upgraded and expanded to meet a majority of public expectations. Some uneconomical, low-use sites would still be closed if upgrading them would not adequately serve the public and allow priority projects to be completed. There would be similar improvements as in Alternative C-1 such as the expansion or improvements at existing horse camps, continued efforts to develop the Caney site resort at Cave Run Lake, addition of Level 2 campsites in the Red River Gorge, upgrading facility amenities with RV hook-ups, modern toilets, improved lighting, added accessible features for the disabled, and more boat docks. Additional improvements for this alternative would include the addition of established campsites with water and electrical hook ups at horse camps, as opposed to simply improving parking lots and providing potable water. Another example might be the addition of new group-use facilities in places where no recreation site currently exists. PAOTs would increase from the 16,175 offered in C-1 to 16,575. Most of this increase would be from additions to the more highly developed sites.

Dispersed Recreation: Off-highway vehicle (OHV) trails less than 15 miles long would be considered for closure, along with a few other trails. Lack of adequate miles of OHV and horse trails would be addressed by considering the addition of about 35 miles of OHV trails to current OHV trail systems and construction of a new 40-60 mile OHV trail system. Where possible, current OHV trails would also be connected to provide for longer continuous trails. For horseback riders, an additional 30 miles of trail systems served by horse camps would be considered. An effort would be made to connect DBNF horse trails to those in the Big South Fork National Recreation Area.

The effects of this alternative would be similar to Alternative A, with the exception of some additions to the trail mileage and restrictions placed on some activities, e.g., overnight camping, in more ecologically sensitive locations such as the Riparian Corridor Prescription Area or the Cliffline Community Prescription Area. An increase in trail mileage from the current 612 miles to 725 miles would come from non-motorized trail additions. The OHV trail miles would be approximately eight miles less than currently exists. Also, some rock shelters in the Red River Gorge Geological Area (RRGGA) might be designated for camping, and additional efforts would be made to locate rock-climbing opportunities both inside and outside of the RRGGA.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Recreation in General: The emphasis on quality and quantity of resource products that maximize benefits to local and regional communities would tend to create more developed recreation opportunities and more intensive natural resource commodity production for resources such as timber and minerals. This would increase the possibility of more human impacts on the natural landscape, reducing the area of semi-primitive ROS experiences. However, existing Wilderness areas, Wild and Scenic Rivers, and other legally designated areas, because they comprise most of the Semi-primitive ROS experiences, will limit the effects of various management on ROS experience distribution. In addition, legal requirements to provide a minimum level of resource protection for emphases such as PETS and water quality, as well as old-growth considerations, will further limit impacts on the landscape. The fact that much of the land is unsuitable for commodity production would limit the scope of impacts from this alternative on ROS distribution. Areas with viable management opportunities are probably already well roaded. Wilderness and Wild Rivers management would follow the ROS Primitive model until the Limits of Acceptable Change process was complete. No areas on the DBNF qualify as ROS primitive as currently defined, however. Thus, while there would be little change in Semi-primitive areas, many of which are in specially designated areas, there would also be few changes in other ROS experiences. Future timber, wildlife, and minerals activities, by themselves, might change the ROS experiences in which they occur but would not move much acreage out of Roaded Natural.

Interpretation and environmental education would remain at a similar level to Alternative C-1 unless fees can be charged that will help offset some of the costs to the government.

Developed Recreation: The recreation program would follow a more business-oriented philosophy, especially as it relates to increasing tourism. Market-level fees might be charged at sites that are now free. Uneconomical sites, whether low-use or not, might be closed if they could not be upgraded to produce some financial returns and/or provide a demonstrated public need. Some smaller, remote sites might be closed if they do not maximize benefits to local or regional communities.

Amenities that would draw larger numbers of visitors would be added to recreation sites. Development Level 4 and 5 fee-generating recreation facilities would be expanded to accommodate more users and would be upgraded with amenities that would add revenue for the facility and local economies as well as meet market demand.

Dispersed Recreation: Off-highway vehicle (OHV) trails less than 15 miles long would be considered for closure, along with a few other trails. Lack of adequate miles of OHV and horse trails would be addressed by considering the addition of about 20 miles of OHV trails to current OHV trail systems and construction of a new 30-40 mile OHV trail system. Where possible, current OHV trails would also be connected to provide for longer continuous trails. For horseback riders, an additional 20 miles of trail systems served by horse camps would be considered. An effort would be made to connect DBNF horse trails to those in the Big South Fork National Recreation Area.

The effects of this alternative would be similar to Alternative A, with the exception of some additions to the trail mileage and restrictions placed on some activities, e.g., overnight camping, in more ecologically sensitive locations such as the Riparian Corridor Prescription Area or the Cliffline Community Prescription Area. An increase in trail mileage from 612 miles to 685 miles would come from non-motorized trail additions. Total OHV trail miles would be approximately 20 miles less than what currently exists due to closure of smaller, scattered trails. Also, some rock shelters in the Red River Gorge Geological Area (RRGGA) might be designated for camping, and additional efforts would be made to locate rock-climbing opportunities both inside and outside of the RRGGA.

To produce additional income and make trail operations and maintenance more economical, charging fees for high maintenance activities such as OHV and horse use would be considered.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

WILD AND SCENIC RIVERS (DESIGNATED AND PROPOSED)

Affected Environment

Overview of All Rivers

The Daniel Boone National Forest has only one federally designated Wild and Scenic River-the Red River. A 19.4-mile segment of this river was added to the National Wild and Scenic Rivers System (National System) December 2, 1993 (Public Law 103-170). In addition, the Forest Service has proposed 67.8 miles of five streams on the Forest for inclusion into the National System. Based upon an EIS (USDA Forest Service 1996) a proposal that segments of the Cumberland River, Marsh Creek, Rockcastle River, Rock Creek and the War Fork part of Station Camp Creek be classified as National Wild and Scenic Rivers, has been forwarded to the Regional Forester for submission to the Secretary of Agriculture and then to Congress for legislative action. No action has yet been taken on this recommendation. Except for Marsh Creek and the recreational portion of the Red River, the Commonwealth of Kentucky has designated these streams as State Wild and Scenic Rivers.

The decision to designate a river as a National Wild and Scenic River is based in part on a determination that the river possess one or more qualities such as outstanding scenic, recreational, geological, fish, wildlife, historic, cultural or similar values, including being a free flowing river. While the Red River has already been officially designated, these qualities would need to be protected for the other rivers if they are to continue to qualify for this designation. So, in addition to protecting the free-flowing condition, water quality and outstandingly remarkable values for which the Red River was added to the National System (U.S. Forest Service 1988, Wild and Scenic River Study Report and Environmental Impact Statement on the Red River), the Forest has also attempted to protect the free-flowing condition and outstandingly remarkable values of the five eligible streams (U.S. Forest Service 1996, Final Wild and Scenic Rivers Suitability Study and Environmental Impact Statement for Six Rivers on the Daniel Boone National Forest) in spite of the fact that they are not yet designated.

Wild and Scenic Rivers are further broken down into three classes: Wild, Scenic and Recreational. Each of these classes determine the type of management and protection that particular river segment receives. Table 3 - 74 lists the designated and proposed rivers and the classes that apply to each.

The Forest has also entered into a memorandum of understanding with the Commonwealth of Kentucky to cooperate in the protective management of these rivers.

Table 3 - 74. Status, designation, and mileage of Wild and Scenic Rivers on the DBNF.

River	Status Federal and (State)	Wild (miles)	Scenic (miles)	Rec. (miles)	Total Miles
Red River	Designated (State W&SR-Wild Segment)	9.1	0	10.3	19.4
Cumberland	Eligible (State W&SR)	0	14.9	0	14.9
Marsh Creek	Eligible	7.0	0	8.0	15.0
Rockcastle	Eligible (State W&SR)	0	13.3	0	13.3
Rock Creek	Eligible (State W&SR)	0	0	17.5	17.5
War Fork Station Camp	Eligible (State W&SR)	0	7.1	0	7.1
Total		16.1	35.3	35.8	87.2

Red River Management

The Wild and Scenic Rivers Act requires a comprehensive river management plan for designated rivers such as the Red River. That plan is to "address resource protection, development of land and facilities, user capacities and other management practices necessary or desirable to achieve the purposes of this Act." The Forest Plan that results from the analysis in this DEIS is designed to meet the comprehensive river management requirements for the Red River. This would be accomplished in Chapter 3 of the Forest Plan (Desired Future Condition, Goals/Objectives/Standards) and its Monitoring and Implementation Appendix. In addition to the management direction in the Forest Plan, additional specific management direction will be provided from the completion of the Limits of Acceptable Change process that will be done with public input. This direction will address in more detail such things as user capacities and management activities, including monitoring and impact mitigation.

The following information details the affected environment of the Red River in support of the analysis and subsequent Plan direction for management of the Red River.

Outstandingly Remarkable Values

The outstandingly remarkable values of the Red River are described as part of the affected environment of this river. The following information taken primarily from the Wild and Scenic River Study Report and Environmental Impact Statement on the Red River (USDA Forest Service 1998) summarizes these values:

Scenic Value: The Red River is a central feature of the Red River Gorge Geological Area (RRGGA). The eastern part of the RRGGA contains the Clifty Wilderness, which is bisected by the wild segment of the Red River. Because of its outstanding natural features the RRGGA is also designated as a National Natural Landmark. Towering sandstone cliffs, rock shelters, natural stone arches, and mountain streams graced by huge boulders, as well as mountain laurel and rhododendron characterizes this area.

The area has been the subject of such accolades as, "The Red River Gorge is one of the unique natural resources of the eastern United States. Its scenic beauty, geological formations, and concentrations of natural arches rival those of the canyon lands of Colorado." (Wyss and Wyss 1977), and the Red River Gorge possesses "a marvelous collection of palisades, rock promontories, solitary pinnacles and spires, numerous natural arches, and a multitude of cascading mountain streams." (Rucchoft 1976) The Red River has been described as "some of the most spectacular canoeing waters anywhere in the eastern United States…. The scenery is spectacular without exception." (Sehlinger 1978) While the above are subjective observations, under the more objective Forest Service scenic classification system, the River and its corridor would have the highest scenic rating, "distinctive," due to the steep and rugged topography, visual variety displayed by the contrasting forests of large trees towering over mountain laurel and rhododendron and large sandstone cliffs and arches.

Recreational Value: The Red River draws river enthusiasts from all over Kentucky as well as surrounding states. Rugged shorelines edged with steep rock cliffs and a river with abundant large boulders provides canoeists and kayakers a variety of white water from Class II and III during the winter and spring run-offs to Class I during the low water flows of summer. In addition, numerous National Recreation trails in the RRGGA provide access into the river corridor for more sedate activities such as viewing scenery and wildlife and hiking into the forest to camp and relax. The RRGGA is internationally known as having some of the world's premier rock climbing areas, some of which are within the river corridor. There has been a steady increase in recreational visitation to the RRGGA because of the quality of its rock climbing routes, numerous trails, white water, and unique scenic qualities. However, limited access to the river has kept use here fairly low with no major changes in the past 5 years.

Geological Value: As described above, the RRGGA is designated as a geological area because of its unique geology, which has produced numerous natural arches, pinnacles, and prominent cliffs. The area contains unique and rugged topography. Most ridges harbor clifflines with rock shelters at their base. Perhaps the most striking feature of the RRGGA is the sandstone arches carved out by years of wind and water erosion. The most popular arch is Sky Bridge, a graceful arch over 70 feet long and 23 feet tall. Another arch is Princess arch, over 30 feet long and 8 feet tall. With over 100 known arches, the RRGGA is thought to contain the largest concentration of arches east of the Rocky Mountains.

Historic and Cultural: The uniqueness of the RRGGA and its river corridor is not only a draw for present day adventurers, but as long as 10,000 years ago, it drew Native Americans to its natural beauty and abundant resources. The dry microclimate of the rock shelters that were a primary abode of early Americans have preserved, to this day, woven fiber slippers, fiber bags filled with nuts, and wooden tools, as well as the remains of cultivated and uncultivated plants. Preservation of these artifacts has produced an important and unique insight into the culture of ancient Native Americans. Wyss and Wyss (1977) state, "The prehistoric archeological sites of the Red River Gorge area are well known for excellent preservation of normally perishable ethnobotanic remains, the bulk of which have been recovered from sites of the Woodland Tradition. The remains of about 50 species are present in these collections." The numerous petroglyphs in the RRGGA are an important addition to the artifacts mentioned above. The RRGGA reportedly has the highest concentrations of petroglyphs east of the Rocky Mountains.

In addition to the unique archeological features of the RRGGA, there are remnants of historical interest. Old saltpeter mine activity from as far back as the Civil War era can be found in some rockshelters. In the 1880s there was a boom in logging activity in the area. The Nada tunnel, the western portal for the RRGGA, is a narrow tunnel dug out of the rock originally for a narrow-gage rail line to haul logs out of the area.

The significance of the hundreds of archeological and historical sites, many of which are on the National Register of Historic Places, is such that the entire RRGGA is being nominated as a National Historic Landmark.

Botanical Value: The conjunction of several climatological, geologic, and topographic features has created a diversity of plant life in a variety of ecological niches. Of particular interest is the drip line area at the base of cliff lines where rock shelters exist. These areas provide suitable environment for the white-haired goldenrod a plant found nowhere else on earth than in the RRGGA.

Aquatic Value: The river environment contains three at-risk aquatic species in addition to 16 mussel species. It also provides a high quality warm-water fishery of 70 fish species, including sport fish such as rock bass, catfish, and smallmouth bass, as well as numerous types of sunfish and muskellunge. The river is one of the few free-flowing muskellunge streams in Kentucky.

The eastern sand darter, which was once common in several of Kentucky's rivers (Woolman 1892), has almost vanished in much of Kentucky because of stream channelization, dam construction (Branson 1977), and siltation (Clay 1975). This species requires clean sand in moderate to large rivers (Williams 1975). While the species can no longer be found in many of its former habitats, it is still present in the Red River.

While not considered as outstandingly remarkable values, the following provide additional information on the affected environment of the Red River:

Red River Water Conditions: With the exception of two state highway bridges, the Red River has no impoundments, diversions, or other modifications on the designated segments. The highest monthly flows are between February and March with the lowest from September to October. The low mean is 86 cubic feet per second and the high mean is 1,075 cubic feet per second. Peak flows are between 5,000 and 15,000 cubic feet per second (Walker 2001b). Distribution of flows, compared with rainfall, indicates that geology influences movement of rainfall into the stream. This influence is the apparent capability to store rainfall as groundwater and slowly release this water as surface streamflow (USDA Forest Service 1988).

Water quality meets or exceeds federal standards (Walker, personal communications 2002). As far back as the late 1970s, water quality has been examined on the river. In 1979 the Kentucky Nature Preserves Commission investigated biota in the Red River. From their findings at a site just down stream from the bridge over the river at State Route 746 at the upper terminus of the Wild Segment of this river the investigators concluded: "This site appears to have some of the highest quality water observed in the Kentucky River Drainage" (Harker, et al 1979). The high quality of the water in 1979 was also confirmed in Kentucky State Nature Preserves Commission studies that found the species representation of benthic macro-invertebrates "reflects the high quality of this stream" (KNPC 1979). While water quality continues to remain good, there are areas of the watershed, mostly outside the RRGGA, that could be improved (Walker 2001b). Water from tributaries outside the RRGGA contains some pollutants, primarily from roads, agricultural run-off, garbage dumping, and sewage discharge.

Red River Classifications and Developments: The 19.4 miles of the Red River has both Wild and Recreational River classifications. The Wild segment of the river is in the upper reach of the river and starts at the bridge that crosses the river on State Route 746. The Wild segment terminates 9.1 miles from this point at the mouth of Swift Camp Creek, approximately 600 feet upstream of the State Route 715 Bridge. This is the only segment of the river designated by the Commonwealth of Kentucky (1980) as a State Wild and Scenic River. Approximately five miles of the upper reach of the Wild segment is outside the Daniel Boone National Forest proclamation boundary and the remainder if this segment is within the Clifty Wilderness portion of the Red River Gorge Geological Area. There are no developments within the corridor inside the wilderness area other than some trails. Outside the Wilderness, beyond the proclamation boundary the steep terrain precludes most development. Most of the rest in this section of the corridor is comprised of mostly forested private land with a few areas of pasture and cropland.

The Recreational segment of the corridor is 10.3 miles long and extends from the mouth of Swift Camp Creek to the river ford below Schoolhouse Branch. This segment is entirely within the RRGGA and includes some trail segments, two canoe-launch sites, trailheads, pastureland and the Gladie Historic Site. Additionally, there are portions of three public roads and some private land more fully discussed in the following section of this document. The corridor is generally described as a line 300 feet north and parallel to the north edge of State Routes 23, 77, and 715, except for the section between Greasy Branch and Bell Branch where the boundary is the south edge of State Route 715. On the southern side, the Recreational segment boundary is a line 800 feet from and parallel to the southern edge of the river.

Private Land Use: Except for the five-mile long river segment east of the DBNF proclamation boundary, most of the private land (555 acres) within the 2,678-acre Red River Wild and Scenic corridor is on the recreational segment of the river. The majority of the private land in the corridor is steep, forested land that cannot be developed. The developable land consists of small tracts, which contain private residences or are not developed, except for clearing of trees to create small (<10 acres) grassy openings or pastures. Even though no county zoning regulations exist, there are few negative impacts from these lands on the corridor within the proclamation boundary. An emphasis on land acquisition in the RRGGA has allowed the Forest Service to acquire much of the private land in the RRGGA. Since 1986, a total of 6,795 acres has been acquired from willing sellers. Several private tracts within the river corridor were acquired as part of this program.

There are also eight miles of public roads that parallel the recreational segment of the river. While the land in the state road right of way DBNF property, the state is responsible for maintenance of the right of way. Recently, nomination by the Commonwealth of Kentucky was successful in having state roads within the corridor designated as part of the National Scenic Byway system.

The five-mile long segment of the corridor that is outside of the forest proclamation boundary is primarily private land in small farms. Almost all of the land immediately adjacent to the river, which makes up the majority of this section of the corridor, is forested, steep, and undeveloped. Above the steep sides of the river, the corridor is mostly forested with some small areas of pastureland.

Red River Recreation Use: As stated in the introduction to the Recreation section of the Affected Environment chapter, there are no “hard” recreation-use figures for the Forest. This is also true of the Red River. Observations, by Forest Service personnel and information from the local outfitter, indicate slow growth in river use over the past five years. The outfitter reported taking 1,145 people out on the river in 2002. About 20 groups use the available shuttle service annually. However, many persons using the river do not use outfitter services.

Crowding and adverse resource impacts have not been a concern in the river corridor due to the wilderness designation along half of the river. The very rough terrain along the entire river also limits both boating access and parking. Because of its current low use and the river’s steep terrain and limited access, future recreation use is expected to grow only slightly during the planning period.

EFFECTS COMMON TO ALL ALTERNATIVES FOR ALL RIVERS

DIRECT AND INDIRECT AFFECTS

For purposes of assessing the direct and indirect effects to recreation of the various alternatives, the area of consideration is National Forest System land within each river corridor. Cumulative effects are assessed on National Forest System lands as well as adjacent private land.

CUMULATIVE EFFECTS

The Forest's cooperative efforts with the Commonwealth of Kentucky to protect and manage these rivers, most of which are also designated State Wild and Scenic Rivers, would continue.

Private development adjacent to, or within, the rivers' corridors could affect the recreation opportunity setting, and thus the recreation experience, in the affected area. Persons desiring to get away from human influence and experience more solitude on National Forest lands might avoid such affected areas.

Private activities and development adjacent to the rivers' corridors could introduce more illegal activities such as OHV use off of designated trails.

The possibility of adverse environmental impacts from certain damaging insects, diseases, and invasive non-native species could require restrictions on recreational activities deemed to increase the chances of these species spreading onto and through the rivers' corridors.

Private development affecting water entering the river watersheds would affect the quality of the water in the rivers.

Increased interest in the Red River Gorge could heighten the desire of the public to acquire lands within these corridors, making increasingly difficult the acquisition of private land for protection of the corridors.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Red River: Protection of the values for which the Red River was designated would continue. Additional protection would also be afforded the river because of its location within the Clifty Wilderness and the Red River Gorge Geological Area and National Natural Landmark. Land acquisition from willing sellers in the river corridor would continue. While this alternative would protect river values, it would not provide river-specific direction to protect and enhance identified values, establish a monitoring plan, or suggest future management actions. Additionally, this alternative would not provide all the direction necessary to meet the intent of the Wild and Scenic Rivers Act [Section 3 (d)(1)].

Proposed Rivers: Protection of the values for which these rivers were proposed would continue. However, the protection would be on an informal basis without much specific direction on how to protect these values.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

ALTERNATIVES B-1, C, C-1, D, E-1

DIRECT AND INDIRECT EFFECTS

Red River: The Forest would have a suite of management direction to fully protect and enhance the Red Wild and Scenic River. This direction would include, and build on, the protective direction for the Clifty Wilderness and RRGGA, adding river-specific direction by segment.

More specific, formal direction would also provide an improved basis for insuring better relationships with our partners and landowners within the corridor.

The two Prescription Areas 3.C.1 and 3.C.3 (Red River Wild segment, Red River Recreational segment) and a monitoring plan for the Red River in the 2004 Forest Plan would address the requirements for a comprehensive management plan under Section 3(d)(1) of the Wild and Scenic Rivers Act.

Proposed Rivers: These alternatives would fully protect and enhance the values for which these rivers were proposed based upon Prescription Areas 3.C.2 (Marsh Creek-Wild segment), 3.C.4 (Cumberland, War Fork, Rockcastle Scenic segments), and 3.C.5 (Rock Creek, Marsh Creek-Recreational segments).

More specific, formal direction would also provide an improved basis for insuring better relationships with Forest Service partners and landowners within the corridor.

CUMULATIVE EFFECTS

None other than those documented above in Cumulative Effects Common to All Alternatives.

WILDERNESS (DESIGNATED AND PROPOSED)

Affected Environment

There are two designated Wilderness areas on the Daniel Boone National Forest. Public Law 99-197 established Clifty Wilderness, part of the Red River Gorge Geological Area, on December 23, 1985. Beaver Creek Wilderness was established by the Eastern Wilderness Act of 1975 (Public Law 93-622). Each is has its own Prescription Area designation.

Clifty Wilderness contains 12,646 acres and Beaver Creek contains 4,791 acres. Both acreages reflect all land, private and National Forest System land, within the boundary designated for these areas. Land and minerals acquisitions have reduced the private land within each one of these wildernesses to less than 100 acres in Clifty, from almost 600 acres in 1997, and 38 acres in Beaver Creek. Social and managerial settings in Wilderness areas are to be managed according to the Primitive Recreational Opportunity Spectrum (ROS) model until the Limits of Acceptable Change process is complete. Due to the small size of both areas and their nearness to roads and developments on surrounding lands, both areas are classed as ROS Semi-primitive Non-motorized.

Logging, farming, roading, nitre mining, and coal mining occurred in these areas in the past. Forest regeneration has erased most remnants of these activities. However, some vestiges of past human impacts and current recreation use in these areas remain, including scattered specimens of non-native invasive plant species. Plants such as multi flora rose, Nepalese brown top, Japanese honeysuckle, autumn olive, and Asiatic bittersweet are the most common of these species. These are usually found along trails, old roads, riparian areas and old home sites. A recent acquisition of private land in the Swift Camp Creek area of Clifty Wilderness includes remnants of an old campground with concrete cisterns, shower house, and an old concrete bridge. Plans were underway to remove these structures by 2003. Another, less obvious human impact is the exclusion of fire that is bringing about a shift in forest species. Of particular note is the increasing amount of white pine in the forest understory.

Because of its nearness to Lexington, Louisville, and Cincinnati and the interest of the public in the spectacular geological features and recreation opportunities in the RRGGA, Clifty Wilderness receives much more use than Beaver Creek Wilderness. The major uses in DBNF Wilderness areas are day hiking, hunting, fishing, camping, and in Clifty, rock climbing. Use in Clifty is concentrated near trails, clifflines, and the Red River Wild and Scenic River. Because the Beaver Creek Wilderness is primarily in the steep, cliff bound drainage of Beaver Creek, use is concentrated along the trails and creeks that lie in the bottom of the steep valleys. In both areas, use is holding steady with some small growth in use noted in Clifty.

Management in these two Wilderness areas has recently focused on surveying and protecting archeological sites at the base of clifflines. There are no major problems in Beaver Creek, but heavy recreation use in Clifty has led to some damage of heritage resources. To address such problems in Clifty, camping and fire building within 100 feet of the base of cliffline has been prohibited, and some popular rock climbing areas have been closed. Follow-up is needed to enforce these closures.

The Wolfpen area, approximately 2,834 acres, is within the Red River Gorge Geological Area and is bounded on the east by Clifty Wilderness and the south by the Red River Wild and Scenic River corridor. It was evaluated by the Forest Service and found to meet the criteria as a Roadless Area in the East as defined in Forest Service Handbook 1909.12. The area has one small tract of rugged private land in the southwest corner that can be accessed without going through National Forest

System lands, two unimproved roads, and a portion of the Sheltowee Trace National Recreation Trail. Past human activities such as logging are fast disappearing. Most human activity is related to dispersed recreation, primarily backcountry hiking and primitive camping. There are some privately held mineral rights within the area.

Environmental Effects

For purposes of assessing the direct and indirect effects to recreation of the various alternatives, the area of consideration is National Forest System and private land within the wilderness boundaries of the DBNF as well as the Wolfpen area. Cumulative effects are assessed on National Forest System lands and private land adjacent to the Wilderness and Wolfpen areas.

ALTERNATIVES A, C, C-1, D, E-1

DIRECT AND INDIRECT EFFECTS

The effects within the Clifty and Beaver Creek Wilderness areas for these alternatives should be essentially the same. There would be no change in designated Wilderness areas or their existing Wilderness boundaries. Acquisition of private lands and mineral rights within the Wilderness areas would continue to be a high priority. The Wilderness experience that visitors have come to expect would continue to be provided at its current level. There would continue to be minor increases in recreational use, especially along trails.

Natural fire would continue to be allowed to play its role in the wilderness ecosystem. Over time, as trees mature and canopies close, shade will create a moister environment with little understory to fuel fire. In dry years, inaccessibility and the reduced ability to use mechanized equipment to suppress arson fires (including fires that threaten Wilderness resources or private lands) could result in fires larger than those that might occur outside the Wilderness areas.

Effects on Wilderness users from possible management activities, resulting from the implementation of the various alternatives just outside the Wilderness boundaries, would be negligible because the rugged terrain surrounding these two areas precludes many management activities.

By not designating Wolfpen as a Wilderness Study Area rock climbing and bolted rock climbing routes would increase along with the potential for more trail construction to accommodate access for the various types of recreation use found in this area. Although natural fire could be allowed, it is likely that most wildfires would be controlled. Other management activities would continue to be minimal due to the management restrictions on the Red River Gorge, of which this area is a part, and due to the rugged terrain in the Wolfpen Area.

CUMULATIVE EFFECTS

Private development adjacent to the Wildernesses would affect the Semi-primitive Non-motorized ROS experiences in that interface. Persons desiring to get away from human influence and experience solitude would avoid such affected areas near the edge of Wilderness areas.

Private development adjacent to the Wilderness areas could introduce more illegal activities such as OHV use.

The possibility of adverse environmental impacts from certain damaging insects, diseases, and non-native invasive species could require restrictions on some types of recreational activities deemed to increase the prospects of these species spreading onto and through the Wilderness areas. As the Forest matures, some shade intolerant non-native invasive plant species will decline.

Private development affecting the water entering the Wildernesses' watershed could adversely affect the quality of the water in the Wilderness areas.

Increased interest in the Red River Gorge/Clifty Wilderness could heighten the public's desire to acquire lands within the Wilderness areas and Wolfpen, making the acquisition of private land to protect the Wilderness areas increasingly difficult.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

This alternative would treat the Wilderness program the same as the other alternatives except that the Wolfpen area would be designated as a Wilderness Study Area. The effects within the Clifty and Beaver Creek Wilderness areas for this alternative would not change. However, Clifty Wilderness area would be enhanced by the addition of approximately 2,834 acres in Wolfpen area.. There would be no change in areas designated as Wilderness or their existing boundaries unless Wolfpen qualifies as a Wilderness, adding to this resource. The wilderness experience that visitors have come to expect would continue to be provided at its current level and could increased if Wolfpen is added to Clifty. There would continue to be minor increases in use, especially along trails however, some current recreation activities in Wolfpen, particularly rock climbing on bolted routes, would not be allowed to increase.

Natural fire would continue to be allowed to play its role in the wilderness ecosystem. Overtime, as trees mature and canopies close, shade will create a more moist environment with little understory to fuel fire. In dry years, inaccessibility and the reduced ability to use mechanized equipment to suppress arson fires as well as any fires that threaten Wilderness resources or private lands. This could result in fires larger than those that might occur outside the Wilderness areas.

Effects on Wilderness users from the potentially different activities just outside the Wilderness boundaries, resulting from the various alternatives, would be negligible because the rugged terrain surrounding these two areas precludes many of the possible management activities. However the protection afforded the western boundary of Clifty by the Wolfpen area would be enhanced.

CUMULATIVE EFFECTS

Private development adjacent to the Wilderness areas as well as Wolfpen would affect setting as well as the recreation experience in the affected interface. Persons desiring to get away from human influence and experience solitude would avoid such affected areas near the edge of these areas.

Private development adjacent to these areas could introduce more illegal activities such as OHV use.

The possibility of adverse environmental impacts from certain damaging insects, diseases, and invasive non-native species could require restrictions on some types of recreational activities deemed to increase the prospects of these species spreading onto and through these areas.

Private development affecting the water entering the watersheds in these areas could adversely affect the quality of the water in the wilderness.

Increased interest in the Red River Gorge/Clifty Wilderness could heighten the public's desire to acquire lands within the Wilderness areas and Wolfpen, making the acquisition of private land to protect the Wilderness areas increasingly difficult.

TIMBER PRODUCTS

The Multiple-Use Sustained-Yield Act of 1960 recognizes timber as one of the five major resources that are available in national forests. In general, national forest timber resources are managed to maintain the diversity of forest vegetation and to provide a sustainable flow of roundwood products for the American economy.

Affected Environment

This section focuses on timber product outputs and values resulting from management rather than vegetation conditions. Resulting conditions are described elsewhere in this chapter (Forest Cover, Forest Health, Fragmentation, etc.).

The area considered for timber supply and demand analysis is a 22 county area centered on the DBNF, containing the market area. Otherwise the area considered for this analysis is National Forest System land within the proclamation boundary.

Timber Supply and Demand

Between 1982 and 1994, acreage of good quality, adequately stocked sawtimber on the Daniel Boone National Forest (DBNF) increased six percent. At the same time, acreage of suitable timberland within the sawtimber class, increased four percent. However, the relatively low demand for DBNF timber cited in the Environmental Impact Statement for the 1985 Plan continues (USFS 1985, p. III-16). As measured by the number of timber sale bids, the past decade has not seen strong demand for DBNF timber. Between 1985 and 1995, DBNF timber sales averaged only 2.5 bidders per offering. The steep slopes and rugged cliffs of the DBNF make logging difficult and more expensive. Also, timber management over the last decade has focused on restoration of sparse and damaged stands. Most offerings, thus, contained a high percentage of medium- to low-value timber. Timber sale contracts on the DBNF require more environmental protection measures than usually occur on private lands. These factors drive up logging costs and hold bids down. For more detailed information on this topic, refer to the Timber Supply and Demand Economic Report: Analysis of the Management Situation (USDA Forest Service 1997).

Timber Management History of the Daniel Boone National Forest

Much timber harvesting and clearing of the land occurred in Kentucky between 1890 and 1910, prior to the initiation of the Cumberland National Forest in 1930 (later renamed the Daniel Boone National Forest). Most of the lands acquired in the 1930s and later had been cut over by the former landowners, often resulting in an under-stocked and/or high-graded condition. Following acquisition and prior to the mid-1960s, the Forest was tended under custodial management that included a series of improvement cuts, although few stands were regenerated. As a result, there are a large number of 70-100 year old stands as described in the Vegetation Cover section in this chapter. In the mid-1960s, an even-aged silvicultural system (including the clearcutting regeneration method) began to be used as the primary method of timber management. During the past decade, a two-aged silvicultural system, using a shelterwood with reserves regeneration method, became the most common regeneration harvest used on the forest. This leaves some older trees to grow with the regenerating trees. Slightly over 10,000 acres is now in a two-aged condition as a result.

Character of Timber Resources on the Daniel Boone National Forest

Timber is a renewable forest product grown from stands of trees, potentially useable for lumber. The volume and quality of wood produced during a logging operation depends on the type and condition of the stand from which such wood is taken. On the DBNF, dry-mesic oak types occupy a majority of uplands, with some dry-xeric oak on rocky sites. Yellow-poplar, eastern hemlock, and other mixed mesophytic and riparian species are often found on moist north slopes and in narrow bands along streams. Yellow pine types and mixtures of pine and oak have occurred mostly in the Cumberland River and Middle Kentucky River Management Areas (watersheds) on upland sites. Virginia pine and other early-seral tree species can be found on previously disturbed areas including mining sites. A more detailed description can be found in the Vegetation Cover section of this chapter.

The Continuous Inventory of Stand Conditions (CISC) timber resource database is updated on a 10-year cycle. One weakness of such a system is that large-scale catastrophic disturbance such as the southern pine beetle (SPB) outbreak, which killed a majority of the yellow pine on the DBNF in 2000 and 2001, cannot be quickly inventoried. For purposes of the analysis done for this section, inclusion of the SPB event was accomplished by replacing most yellow pine stands with hardwood stands in the database. This update left pine in stands having a 30-50 percent pine component (Oak-pine), and in young seedling-sapling pine and young pine-hardwood stands. Based on these changes, as of June 20, 2002, the forest resource was estimated by age-class and community (Table 3 - 75).

Table 3 - 75. Forest land by age-class and community type (acres)*.

	Community Type						
Age-class (year 2001)	Pine & Pine-hardwood	Oak-pine	Xeric Oak	Mesic Oak	Mixed Mesophytic	White Pine Hemlock	Total Forest
00-09	1,272	40,588	1,313	16,649	5,174	317	65,313
10-19	0	2,186	1,663	27,184	10,990	2,963	44,985
20-29	0	3,618	657	27,730	10,690	2,631	45,326
30-39	0	2,048	858	20,985	12,631	2,961	39,482
40-49	0	1,124	486	10,269	11,658	1,271	24,809
50-59	0	1,498	906	10,248	16,703	626	29,980
60-69	0	5,775	2,689	29,065	19,049	1,035	57,613
70-79	0	11,831	3,984	53,432	22,287	2,365	93,900
80-89	0	10,994	4,452	50,484	22,033	3,407	91,370
90-99	0	9,537	5,903	45,905	15,099	2,598	79,043
100-109	0	6,413	3,228	28,778	9,094	3,784	51,297
110-119	0	2,162	1,405	14,858	5,256	2,567	26,247
120-129	0	661	392	3,059	1,862	1,420	7,393
130+	0	212	169	852	1,220	2,597	5,048
Total	1,272	98,647	28,105	339,498	163,746	30,542	661,806

*Acreage based on March 1997 CISC database, adjusted for Southern pine beetle mortality in 1999-2001.

Timberland Suitability Analysis (Stage 1)

Timberland is defined as forestland considered of commercial value, or commercial forestland. As stated in CFR 219.14: "During the Forest planning process, lands which are not suited for timber production shall be identified." Conversely, lands suitable for timber production are also identified. In the following timberland suitability analysis, the final result identifies each acre of land for timber production suitability by alternative.

Stage 1 of this analysis determines lands that are "tentatively suitable" for timber production. Non-forest lands such as lakes, treeless recreation areas and administrative sites, major roads, and transmission line clearings are removed. Lands that have been administratively removed from the timber base such as designated Wilderness areas, Wild and Scenic Rivers, and Research Natural Areas are removed. Also, all lands that are incapable of producing at least 20 cubic feet of industrial wood per acre per average year are removed from the suitable timber base. Table 3 - 76 displays the results of the first stage of this analysis.

Table 3 - 76. Determination of tentatively suitable timberland.

Land Use[1]	Acres
Non-forest	
Water	17,916
Roads	8,704
Railroads	66
Admin & misc. non-forest	2,081
Grassy openings	1,922
Utilities	1,231
Total Non-forest	31,920
Unsuitable Forest (Stage 1)	
Wilderness (Clifty and Beaver Creek)	16,692
RNA (Rock Creek)	189
Wild and Scenic River - Wild	76
Wild and Scenic River – Except Wild	1,181
Scenic Area (Natural Arch)	1,052
Geological Area (Red River Gorge)	15,725
Forestland Not Capable of Adequate Growth[2]	275
Forestland Where Technology Is Lacking[3]	1,246
Total Unsuitable Forest (Stage 1)	36,465
Total National Forest System Lands (1998)	693,726
- Total Non-forest	-31,920
Total forest land	661,806
- Total Unsuitable Forest (Stage 1)	-31,920
= Tentatively Suitable Timberland	625,341

[1] This list is prioritized so that where overlapping polygons occur between land uses, the uppermost listed contains the acres.

[2] Lands incapable of 20 cu.ft. /acre-year of growth; formerly "unproductive" forest (CISC code 900)

[3] Lands where restocking can't be assured, or where response data is lacking, e.g. uninventoried (CISC code 700)

Timberland Suitability Analysis (Stage 2)

The Stage 2 timberland suitability analysis is an economic examination of the tentatively suitable timberland identified in Stage 1 above, as required in 36 CFR 219.14(b). No decisions are made at the conclusion of the Stage 2 analysis about the management of the land. Instead, the results are used in the Stage 3 analysis, which determines land allocations for each alternative.

The Stage 2 analysis was accomplished by dividing areas of Forest that are potentially available for timber production (tentatively suitable timberland) into analysis areas based on forest community types, stand-age, slope, and accessibility. This analysis used Present Net Value (PNV) to measure of timber costs and revenues. The results of this analysis are summarized in Table 3 - 77. Unroaded acres have the highest impact on cost, then operability (slope). Mesic oak types have the highest value while the yellow pine types have the lowest. Even though yellow pine is considered to be a mid-value product, its PNV is negative since most yellow pine stands are now in young age-classes.

Table 3 - 77. Present net value of average-age timberland, by accessibility, operability, and community type (1997 $/acre).

	Community Type					
Operability/ Accessibility	Yellow Pine & Pine-hwd (50+% pine)	Oak-pine (50-70% hardwood)	Xeric Oak (poor site)	Mesic Oak (good site)	Mixed Mesophytic Hardwoods	Hemlock – White Pine
Gentle slope/ Roaded	-$8.67	$81	$133	$204	$138	$99
Steep slope/ Roaded	*	$108	$124	$133	$124	$74
Gentle slope/ Unroaded	-$16	$58	$92	$132	$91	$56
Steep slope/ Unroaded	*	$57	$74	$85	$87	$80

* Not enough representative stands available on these sites for reasonable analysis.

Timberland Suitability Analysis (Stage 3)

Stage 3 was accomplished during the formulation of alternatives. According to 36 CFR 219.14(c), in this stage, "lands shall be tentatively identified as not appropriate for timber production to meet objectives of the alternative being considered if":

1) Based upon a consideration of multiple-use objectives for the alternative, the land is proposed for resource uses that preclude timber production, such as Wilderness
2) Other management objectives for the alternative limit timber production activities to the point where management requirements set forth in 219.27 cannot be met, or
3) The lands are not cost-efficient, over the planning horizon, in meeting forest objectives, which include timber production.

The results of land allocation by alternative are displayed in Table 3 - 78. Lands determined to be not cost-efficient were removed from the Tentatively Suitable Timberland classification based on criteria such as accessibility, operability, and soil sensitivity. This information was gathered during field observations over the past decade and recorded in the CISC database. The amount of this acreage is included in the table as Economically Unsuitable Lands.

RESOURCE TABLES

The tables and figures in this section are discussed in the Environmental Effects section.

Table 3 - 78. Allocation of land not appropriate for timber production by alternative (acres).

Land Allocated as Not Appropriate for Timber Production[1]	Alternative			
	A	B-1	C, C-1, and D	E-1
2.C. Proposed Wilderness	0	*0	0	0
1.A. Proposed Research Natural Areas[2]	161	161	161	161
3.C.2. Proposed Wild & Scenic River- Wild	1,194	1,194	1,194	1,194
3.C.4. Proposed Wild & Scenic River- other	11,042	11,042	11,042	11,042
1.G. Rare Community	0	858	858	858
I.J. Significant Bat Caves	0	5,260	5,260	5,260
1.C. Cliffline Community	0	95,538	95,538	95,538
1.I. Designated Old-Growth	0	0	12,141	315
Red-cockaded woodpecker Mgt. Area	3,552	0	0	0
3.A. Recreation Areas (forested area)	2,414	2,136	2,091	2,136
3.B. Lake Zone (300' forested area)	12,830	10,657	10,319	10,657
1.E. Riparian Corridor (98% unsuitable)	0	95,971	93,269	95,955
Wooded Grassland (long-term objective)	0	750	18,375	750
1.M. Custodial (81% unsuitable)	0	330,752	0	0
Grassy openings Reverting to Unsuitable	0	1,022	0	0
Economically Unsuitable Lands	15,265	0	7,010	7081
Total Not Appropriate	46,458	555,341	257,258	230,947
Tentatively Suitable Timberland (Table 3 - 76)	625,341	625,341	625,341	625,341
+/- Grassy openings to revert / (to clear)	-778	0	-278	1,022
- Total Not Appropriate	-46,458	-555,341	-257,258	-230,947
= Total Suitable Timberland	578,105	70,000	367,805	395,416

[1] This list is prioritized so that where overlapping polygons occur between land types, the uppermost listed contains the acres.

[2] Includes Elisha Creek, but excludes Tight Hollow since it is within the Red River Gorge Geological Area, already classified as unsuitable.

* The proposed Clifty Wilderness addition (2,834 acres) is all within the Red River Gorge Geological Area, already classified as unsuitable.

Table 3 - 79. Silvicultural activities by alternative for the first decade (average annual acres).

Alternative	Silvicultural Activity						
	Shelterwood with ~15 BA reserves	Thinning to ~60-80 BA residual	Wooded Grassland Restoration ~15 BA residual	Woodland Restoration ~40 BA residual	Uneven-aged Selection (Riparian forest)	Pine Restoration (Site Prep & Release)	Natural Regen. (Site Prep)
A	3,000	1,500	0	0	0	2,083	2,917
B-1	296	183	72	323	164	436	264
C	1,428	900	77	567	164	822	1,406
C-1	1,428	900	77	567	164	822	1,406
D	1,428	900	77	567	164	822	1,406
E-1	3,225	2,399	72	323	164	436	3,200

Table 3 - 80. Timber program quantity (MMCF) for first decade, by alternative and product.

Product	Alt. A	Alt B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Sawtimber - Softwood	3.7	0.5	2.0	2.0	1.9	4.0
Sawtimber - Hardwood	32.1	4.0	17.1	17.3	17.0	35.4
Small Roundwood - Sfwd.	.6	0.1	.3	.3	.3	.7
Small Roundwood - Hdwd.	6.1	0.8	3.3	3.3	3.2	6.7
Total	42.5	5.3	22.7	22.9	22.5	46.9

Table 3 - 81. Allowable Sale Quantity (MMCF) per decade by alternative.

	Decade						
Alternative	1st	2nd	3rd	4th	5th	10th	15th
A	40.7	48.9	48.9	52.9	52.9	52.9	52.9
B-1	5.1	5.1	5.1	6.0	6.0	11.7	11.8
C	21.7	26.1	26.1	30.9	30.9	36.7	36.7
C-1	21.9	26.5	26.5	30.5	30.5	36,.8	36.8
D	21.5	26.5	26.5	30.7	30.7	35.7	35.7
E-1	44.9	44.9	44.9	48.4	48.4	55.7	57.0

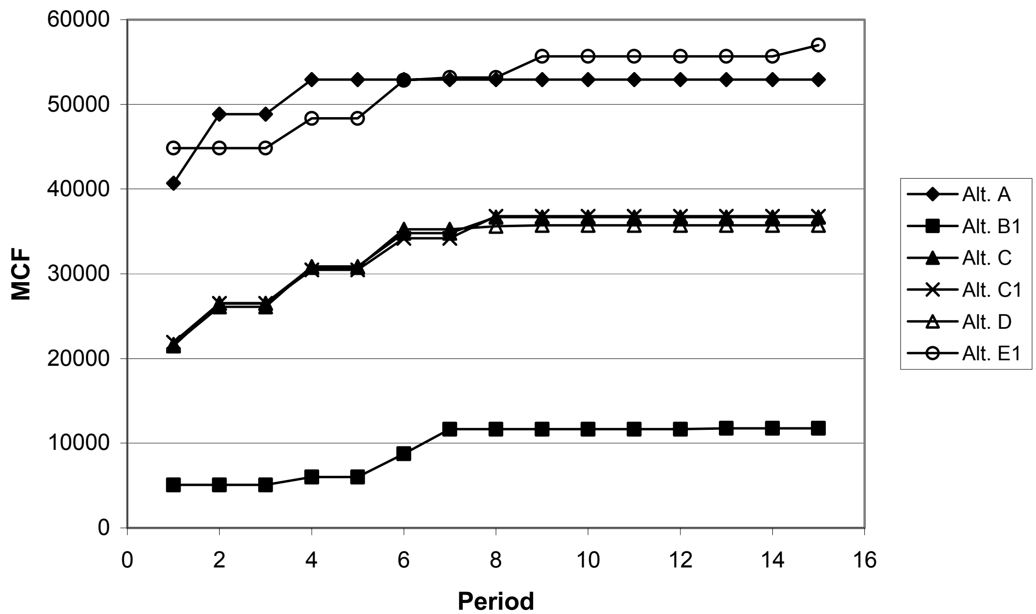

Figure 3 - 45. Allowable Sale Quantity Per Decade (Period).

Environmental Effects

This section describes the factors within each alternative that would affect the Forest's output of timber products. As a result of management for various objectives, the Forest would produce industrial roundwood for delivery to mills that produce rough and dimension lumber, pallet wood, veneer, posts, poles, oriented strand board, bark mulch, and other timber products. Such timber products are an important economic resource within the human environment.

The following indicators measured the effects of the alternatives on timber production:

- Area of timberland available for timber production (suitable timberland)
- Area and types of treatment planned
- Allowable sale quantity (ASQ) of timber that could be produced on suitable timberland
- Program quantity/decade of timber that is estimated to be produced on all forestland
- Relative changes from existing trend in quality (value) of timber.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Economic Factors - All Alternatives

Regardless of the reason for the timber harvest, all alternatives would attempt to produce timber at regular intervals. In general, timber sales would be offered regardless of market conditions to maintain desired conditions on a regular basis. Additionally, supply from the DBNF is somewhat "inelastic." Holding back prepared sales for months or years waiting for better prices is impractical. This focus on production could be seen as depressing market prices to the disadvantage of the Forest's timber supply competitors (private timberland owners in the Forest's economic zone). Conversely, any local mills that might be operating at margin could benefit from timber sales offered on a regular basis. However, demand within the Forest's entire market area should not be significantly affected by any alternative since the DBNF timber program has minimal influence on overall market prices (USDA Forest Service 1996).

Revenue from timber sales is affected by several factors that influence bidding on timber sale contracts. Such factors include the type of harvest methods required in the contract, the quality and quantity of various types of timber products offered for sale, varying land characteristics where the harvest takes place, and the non-traditional Forest Service contract requirements that are seldom imposed on private lands. Costs of reforestation vary based on ground conditions and the reforestation methods prescribed.

Thinning (commercial, non-commercial, and/or pre-commercial) is planned in all alternatives. Although revenues from commercial thinning rarely exceed costs, the long-term benefits of increased stand vigor and resulting resistance to insect and disease outbreaks is often justified. Long-term timber value is increased as the risk of stand collapse is reduced and growth is concentrated on higher value trees. Generally, when thinning occurs, once habitat needs are met, trees are selected for cutting for the purpose of increasing stand diversity, capturing future mortality, and improving overall vigor and quality of timber within the residual stand.

Economic impacts of the timber program are presented in the socio-economic section of this chapter. The Forest Service is required to stay within an annual budget for each program. Cost efficiency is considered in program management and project implementation. Otherwise, no economic goals have been established for the timber program, since the program is considered a tool to achieve desired conditions in all alternatives considered in detail. An alternative that emphasized only economics (Alternative E) was eliminated from detailed study (see Chapter 2).

Effect of the Long Term Sustained Yield Goal – All Alternatives

One of the Forest's mandates, regardless of alternative, is to provide renewable products on a sustainable basis, when such provision is compatible with desired future conditions (Table 3 - 81). A sustained flow of wood (at any desired level) requires a forest where growth equals or exceeds mortality plus removals. Timely and adequate regeneration of stands of trees is a factor in timber growth.

For each alternative, an allowable sale quantity (ASQ) has been estimated through the use of the Spectrum model through 15 decades (Appendix B). The model has built-in constraints that ensure a non-declining even flow and that ensure harvest levels will not exceed the long-term sustained yield. Therefore, all alternatives should leave at least as much standing timber after 10 years as exists today. A sustained yield would also be tracked through the use of continuous Forest Inventory and Analysis (FIA) plot data. This estimate would be monitored through time regardless of alternative.

To help meet desired future conditions in all alternatives, timber could occasionally be harvested from lands classified as unsuitable, including locations such as the Geological Area or portions of the Wild and Scenic River corridors. Such volume would not be counted in the allowable sale quantity (ASQ) estimate because a scheduled harvest cannot be planned for these areas. The total timber program quantity, which includes the ASQ plus the amount harvested from lands unsuitable for timber production, is not expected to be more than 10 percent above the ASQ figures shown in Table 3 - 81 for any alternative.

Effect of Esthetic Considerations – All Alternatives

Occasionally, timber harvest operations would need to be modified when such activities occur near high-use or visually sensitive areas not specifically allocated to a prescription area. Such areas might include certain road corridors, trail corridors, or viewsheds identified in the Scenery Management System. Such modifications could influence location of temporary access roads, increased number of leave trees, special design of harvest edge, and/or treatment of slash. Although a few projects could be highly affected, such modifications would have an overall insignificant negative effect on timber production in all alternatives Forestwide. Most visually sensitive areas are found in prescription areas with low levels of vegetation management.

Effect of Prescribed Burning – All Alternatives

Under any alternatives, regeneration areas may be burned during site preparation. Since site-preparation burning has a higher intensity (hotter) than understory burning. The trees remaining in these areas as seed trees or shelterwood would be expected to succumb or receive varying amounts of fire damage. Depending on adjacent fuels, many could over time develop basal cavities decreasing tree and log grades. However, with careful preparation of fuels prior to burning, this effect can be minimized (Brose 1999). Even if some damage occurs, the positive effects of site preparation would outweigh any loss of quality in the residuals.

Prescribed understory burning would occur under all alternatives. Where this activity occurs in older stands of oak, there would be little impact on quality of timber in the existing stand. In such stands, fire often favors advanced oak regeneration. In younger, pole-sized timber stands containing a mixture of oak and other hardwoods, a species-selective thinning effect often occurs. Trees with thicker bark and higher value such as oak are favored over thin bark, lower value trees such as red maple and beech (Abrams 2000). In seedling/sapling stands, tree species that sprout and have well-developed root systems such as oak, are favored over other lower value hardwoods, where fire has occurred (Van Lear 2000). Natural pine regeneration often occurs where fire has reduced duff and a seed source is present.

Although prescribed understory burning would typically be low in intensity, small pockets of higher intensity fire could occasionally occur and cause scars on the lower bole of trees, especially where fuels accumulate on the uphill sides. Such fire scars may not always callous over or compartmentalize effectively and can be entry points for rot-causing fungi and other disease. The small fire-damaged pockets would typically develop more live and/or dead trees containing cavities and associated rot. Such effects are common where wildland fire occurs in uncontrolled conditions. However, when within prescribed conditions, such pockets would normally not occur or make up only a small amount of area.

Therefore, under all alternatives, where burning is applied under prescribed conditions, the overall long-term effect would be increased timber quality.

CUMULATIVE EFFECTS

External Economic Factors - All Alternatives

Market activities outside of the National Forest System lands can affect the quantity of timber products sold and removed from the DBNF. When markets have an ample supply, purchasers may be unable to meet the minimum required bid, resulting in “no-bid” sales.

Effect of Land Use Change – All Alternatives

Between 1974 and 1987 forested land in the three eastern Kentucky Forest Inventory units that contain the DBNF decreased by 0.6 percent (USDA Forest Service 1978, Alerich 1990). Although no more-recent forest survey data are available, this trend will likely continue or level off. Although not yet a significant factor in eastern Kentucky, the Southern Forest Resource Assessment (USDA Forest Service 2002b) has concluded that during the next 20 years in the South, “Urbanization will continue to consume forest land and agricultural land, while rising timber prices will push some agricultural land toward forest uses.” As human population increases in the urban centers within the region and farmlands are developed for urban and suburban uses, people are expected to continue to move from rural into suburban and urban settings. Increasingly, urban users are expecting the National Forest to supply a greater amount of non-timber values, relative to traditional timber values. As a result, lands classified as being suitable for regulated timber harvest are expected over time to take up a smaller proportion of DBNF lands regardless of alternative. Thus, timber production from the Forest would be expected to decline as a result of this trend.

Effect of Special Uses and Mineral Use – All Alternatives

Some land clearing for non-forest uses may occur on the DBNF as a result of special use authorizations to private interests for utility, road right-of-way access, or mineral extraction projects (see Lands and Special Uses section). Other lands may be cleared as a result of new federal or state highways, utility corridors, or reservoirs. Since these activities occur on a site-specific, request and approval basis, they are not decisions based on the results of this assessment. However, the clearing of land would have a small cumulative negative effect on long-term timber production, generally regardless of alternative. When such activity occurs, a small amount of federal timber would be harvested and sold as the land is converted to non-forest use.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Effect of Timberland Suitability Classification

Allocation of tentatively suitable timberland is among the decisions made in the forest planning process. For this alternative, the timberland that is tentatively suitable for timber production from Table 3 - 76 was further classified by subtracting forestland where scheduled timber production would be "not appropriate." The remaining lands would be suitable for scheduled timber production as shown in Table 3 - 78.

With this alternative, several areas of the Forest would be managed for a minimum level of timber products, although still classified as suitable for timber production. A decision was previously made within Plan Amendment No. 11 (USDA Forest Service 2000, ROD) to apply management direction to a zone along clifflines (including significant bat cave buffer zones), which includes restrictions on timber harvest. Lands being considered for classification as Wild and Scenic Rivers and most riparian areas that are often difficult to access would also continue to be classified as suitable. Harvests would continue to be concentrated in areas outside of these restricted areas, although the amount of harvest area would be based on the total suitable acres.

Of tentatively suitable timberland, 92 percent (578,105 acres) would be allocated as suitable for timber production. Eight percent (47,236 acres) of tentatively suitable timberland would be allocated as not appropriate, or cleared for grassy openings (Table 3 - 78). Much of this area (15,265 acres) would be unsuitable due to economic constraints. In the absence of major disturbance, the unsuitable area would continue to increase in value until maturity at an approximate age of 100-150 years and then begin to develop old-growth characteristics. Such characteristics would include a greater proportion of rotten and/or sound culls and increased tree mortality, resulting in lower timber value per acre.

Effect of Ecosystem Management

In a two-aged stand, stand age is currently recorded as the age of the youngest cohort. With two-aged rotation of 80/160 years, approximately 12 percent of suitable timberland would be in age-class 0-10 each decade. When a more even age-class distribution is achieved after approximately two decades, much of the forest cover on suitable timberland would consist of immature trees, based on culmination of mean annual increment of stand volume. This growth would occur even though two-aged stands would contain both immature and mature trees.

Thinning could take place to meet “fully stocked” stocking levels in support of a high level of timber growth. In 1988 the Forest Inventory and Analysis survey estimated that 40 percent of DBNF timberland was overstocked (USDA Forest Service 1988). However, this estimate must be verified on a site-specific basis. Furthermore, very little thinning was accomplished in the past decade since purchasers have had little interest in the small, low-value timber offered in such sales. If not accomplished commercially, non-commercial thinning would not likely occur in this alternative.

Harvest Acreage: Pine restoration in a short period would be a priority since management for red-cockaded woodpecker habitat would continue to be a major goal under this alternative. This alternative includes rotation lengths between 70 and 100 years to eventually create a balanced age-class distribution within each forest type grouping. Harvest of areas to create woodland, wooded grassland, and unique riparian habitats would not occur in this alternative. During the first decade, this alternative would include a thinning objective of 15,000 acres, a final harvest of approximately 30,000 acres and regeneration of about 50,000 acres, including restoration of pine stands as shown in Table 3 - 79.

Harvest Volume: Based on new yield tables developed for this analysis, Alternative A would support the development of a somewhat less than optimum yield of high quality timber, since rotation length appears to have been set shorter than optimum for the 1985 Plan. However, with shorter rotations, risk of loss from insects and disease could be less than for longer rotations. In this alternative, the development and maintenance of various desired wildlife and plant habitat conditions would often result in some volume being removed and some residual live timber left standing for various reasons. This residual volume would reduce the amount of timber potentially available for harvest from each sale unit. The intensity and amount of vegetation management in Alternative A would result in an estimated 42.5 million cubic feet of timber produced from the Forest during the first decade, of which 40.7 would be from suitable timberland as shown in Table 3 - 80 and Table 3 - 81.

Effect of Prescribed Burning

In this alternative during the first decade, prescribed site-preparation burning would be concentrated in 20,830 acres in pine regeneration areas.

An average of 12,917 acres of prescribed understory burning per year would occur in upland hardwood and hardwood-pine stands for fuel reduction and control of understory composition. At this level, a continued reduction in oak and pine regeneration would be expected.

CUMULATIVE EFFECTS

There would be no additional cumulative effects beyond those previously described as common to all alternatives.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Effect of Timberland Suitability Classification

Allocation of tentatively suitable timberland is among the decisions made in the forest planning process. For this alternative, timberland tentatively suitable for production was further classified by subtracting forestland where scheduled timber production would be “not appropriate.” (Table 3 - 76) The remaining lands would be suitable for scheduled timber production. (Table 3 - 78)

Of tentatively suitable timberland, 11 percent (70,000 acres) would be allocated as suitable for timber production. Eighty-nine percent (555,341) of tentatively suitable timberland would be allocated as not appropriate. Most of this would be unsuitable due as a result of allocation of the 1.M Custodial Prescription Area. In the absence of major disturbance, this unsuitable timberland would continue to increase in value until maturity at an approximate age of 100-150 years and then begin to develop old-growth characteristics. Such characteristics would include a greater proportion of rotten and/or sound culls and increased tree mortality, resulting in lower timber value/acre.

Effects of Ecosystem Management

Regular timber harvest under this alternative would occur only to support minimum habitat needs for species viability, safety public, or legal requirements. Such harvesting would include that needed to create a minimum amount of woodland, wooded grassland/shrubland, grassy openings, thinned forest, and some riparian habitats. The amount and type of habitats that would be created and maintained through the first decade under this alternative are displayed in (Table 3 - 79).

Harvest Acreage: Implementation of this alternative would result in approximately one percent of the forest in regeneration each decade. Alternative B-1 prescribes a first decade thinning of 1830 acres and a final harvest of approximately 2,960 acres and regeneration of about 7,000 acres on suitable timberland, including restoration of some pine stands. Yellow pine-dominated stands would be regenerated on 4,363 acres to create a minimum of habitat for species requiring this condition.

Harvest Volume: A relatively low level of timber would be produced as compared to the average level during the previous planning period. The intensity and amount of vegetation management in Alternative B-1 would result in an estimated 5.3 million cubic feet of timber produced from the Forest during the first decade, of which 5.1 would be from suitable timberland as shown in Table 3 - 80 and Table 3 - 81.

Effect of Prescribed Burning

In this Alternative during the first decade, prescribed site-preparation burning would be concentrated on 4,360 acres in pine regeneration areas as shown in Table 3 - 79.

An average of 1,546 acres of prescribed understory burning per year would occur in upland hardwood and hardwood-pine stands for fuel reduction and control of understory composition. At this level, a continued reduction in oak and pine regeneration would be expected. The loss of the oak component would reduce the long-term value of timber Forestwide. Lack of prescribed burning could lead to fuel buildup that would allow the forest to be more heavily damaged by wildland fire (e.g., due to arson), negatively affecting timber quality.

CUMULATIVE EFFECTS

There would be no additional cumulative effects beyond those previously described as common to all alternatives.

ALTERNATIVE C, C-1, D

DIRECT AND INDIRECT EFFECTS

Since these alternatives prescribe only minor variations in intensities of vegetation management and outputs, they have been grouped together.

Effect of Timberland Suitability Classification

Allocation of tentatively suitable timberland is among the decisions made in the forest planning process. For this alternative, timberland tentatively suitable for production was further classified by subtracting forestland where scheduled timber production would be "not appropriate." (Table 3 - 76) Remaining lands would be suitable for scheduled timber production. (Table 3 - 78)

Of tentatively suitable timberland, 59 percent (367,805 acres) would be allocated as suitable for timber production. Forty-one percent (257,258 acres) of tentatively suitable timberland would be allocated as not appropriate, although a small timber sale could occur infrequently in this area for public safety or legal reasons. Most of this area consists of the Riparian Corridor and the Cliffline Community prescription areas. In the absence of major natural disturbance, this area would continue to increase in value until maturing at approximately 100-150 years of age and then begin to develop old-growth characteristics. Such characteristics would include a greater proportion of rotten and/or sound culls and increased tree mortality, resulting in lower timber value per acre. Some of the tentatively suitable timberland could be cleared for permanent grassy openings (278 acres).

Effect of Ecosystem Management

Implementation of Alternatives C, C-1, or D would put approximately five percent of the Habitat Diversity Prescription Area in regeneration each decade. All three alternatives would prescribe desired conditions that would eventually result in suitable timberland having a balanced range of age-classes, with approximately one-half beyond maturity (beyond culmination of mean annual growth increment).

The expected use of a two-aged silvicultural system (average 200/400 year rotation) in these alternatives would allow much of the currently 90-year-old forest to continue to age. Those stands, with a high percentage of red oak, could experience elevated mortality beyond age 100 if oak decline or two-lined chestnut borer becomes prevalent. However, harvest would be expected to be concentrated in such areas, and many of these stands could convert to woodland or wooded grassland. Other forest community types would increase in size and, therefore value, until they reached age 150. Beyond 150 years, quality could begin to decline from the combined effects of insect, disease, and weather damage.

Thinning could take place for two purposes: to meet a viability objective and to meet a stocking level objective in support of forest health. One forest health objective is to prepare the forest for the gypsy moth invasion by taking stands to a stocking level of less than 80 percent (Gottschalk 1993). Achieving this stocking level would generally increase stand vigor, but the amount of thinning needed to accomplish this objective is uncertain. In 1988 the Forest Inventory and Analysis survey estimated that 40 percent of DBNF timberland was overstocked (USDA Forest Service 1988). However, this estimate must be verified on a site-specific basis. Furthermore, very little thinning was accomplished over the past decade since purchasers have had little interest in the small, low-value timber offered in such sales. If not accomplished commercially, the Forest Service would have to bear the cost of thinning. For purposes of the timber analysis, only the viability thinning was considered since it is the most likely to occur.

Harvest Acreage: These alternatives would prescribe a first decade harvest of approximately 14,280 acres and regenerate about 22,280 acres, including restoration of some of the pine stands decimated by the bark beetle. During the decade, various mixtures of yellow-pine and hardwood would be regenerated on 8,220 acres to create a suitable habitat for a range of plant and animal species. Harvest of areas to create woodland, wooded grassland, and other special riparian habitats would also be done at levels needed to maintain optimum levels of certain species. The amount and type of habitats created and maintained through the first decade is displayed in Table 3 - 79.

Harvest Volume: The intensity and amount of vegetation management in these alternatives would result in an estimated average of 22.7 million cubic feet (MMCF) of timber produced from the Forest during the first decade, of which 21.7 MMCF would be from suitable timberland. The Spectrum model estimated that volume under Alternative C-1 could be 0.2 MMCF higher over the decade, while Alternative D could be 0.2 MMCF lower (less than 1 percent) as shown in Table 3 - 80 and Table 3 - 81.

Effect of Prescribed Burning

In this alternative during the first decade, prescribed site-preparation burning would be concentrated in 8,220 acres in pine regeneration areas Table 3 - 79.

An average of 32,500 acres of prescribed understory burning per year would occur in upland hardwood and hardwood-pine stands for fuel reduction and control of understory composition. At this level, natural oak regeneration should improve.

CUMULATIVE EFFECTS

There would be no additional cumulative effects beyond those previously described as common to all alternatives.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Effect of Timberland Suitability Classification

Allocation of tentatively suitable timberland is among the decisions made in the forest planning process. For this alternative, timberland tentatively suitable for production was further classified by subtracting forestland where scheduled timber production would be “not appropriate.” (Table 3 - 76) Remaining lands would be suitable for scheduled timber production. (Table 3 - 78)

Of tentatively suitable timberland, 63 percent (395,416 acres) would be allocated as suitable for timber production. A small portion of this would be former grassy openings that are reforested (1,022 acres). Thirty-seven percent (230,947 acres) of tentatively suitable timberland would be allocated as not appropriate, although a small timber sale could occur infrequently in this area for public safety or legal reasons. Most of the unsuitable area consists of the Riparian Corridor and the Cliffline Community prescription areas. In the absence of major disturbance, the unsuitable area would continue to increase in value until maturing at approximately 100-150 years of age and then begin to develop old-growth characteristics. Such characteristics would include a greater proportion of rotten and/or sound culls and increased tree mortality, resulting in lower timber value per acre.

Effect of Ecosystem Management

In a two-aged stand, stand age is currently recorded as the age of the youngest cohort. With two-aged rotation of 100/200 years, approximately 10 percent of the 4.A Timber Production Emphasis Prescription Area would be in age-class 0-10 each decade. When a better age-class distribution is achieved after approximately two decades, much of the forest cover on suitable timberland would consist of immature trees, based on culmination of mean annual increment of stand volume. This growth would occur even though two-aged stands would contain both immature and mature trees.

Thinning could take place for two purposes: to meet a viability objective and to meet a stocking level objective in support of forest health. One forest health objective is to prepare the forest for the gypsy moth invasion by taking stands to a stocking level of less than 80 percent (Gottschalk 1993). Achieving this stocking level would generally increase stand vigor, but the amount of thinning needed to accomplish this objective is uncertain. In 1988 the Forest Inventory and Analysis survey estimated that 40 percent of DBNF timberland was overstocked (USDA Forest Service 1988). However, this estimate must be verified on a site-specific basis. Furthermore, very little thinning was accomplished in the past decade since purchasers have had little interest in the small, low-value timber offered in such sales. If not accomplished commercially, the Forest Service would have to bear the cost of thinning. For purposes of the timber analysis, only the viability thinning was considered since it is the most likely to occur.

Harvest Acreage: Alternative E-1 would prescribe a first decade harvest of approximately 32,250 acres and regenerate about 36,360 acres, including restoration of pine stands. (Table 3 - 79)

In addition to the primary management objective for timber production, some vegetation management would occur to maintain specific habitat conditions that provide at least minimum viability for certain species. Stands with at least a 50 percent yellow-pine component would be regenerated on 4,363 acres to create at least minimum habitat for certain species. Timber harvest to create woodland, wooded grassland, and other special riparian habitat types would also be done at levels required to maintain minimum populations of certain species. The amount and type of habitats created and maintained through the first decade by this alternative are listed in Table 3 - 79.

Harvest Volume: Rotations would be based on eventually optimizing yield by concentrating harvests around the time when stand growth would reach the culmination of mean annual increment. An increase in value should occur as a result of more volume moving into higher-grade material due to increased size of existing trees. In this alternative, growth would exceed mortality and removals for the first few decades. However in the long-term, growth would equal mortality and removals. Development of the desired balanced age-class distribution would eventually increase the amount of timber available for harvest and increase the average volume production per acre over averages that occurred during the past decade.

As a result of implementation of this alternative, a relatively similar level of timber would be produced as compared to averages during the past decade. The intensity and amount of vegetation management in Alternative E-1 would result in an estimated 46.9 million cubic feet of timber produced from the Forest during the first decade, of which 44.9 would be from suitable timberland as shown in Table 3 - 80 and Table 3 - 81.

Effect of Prescribed Burning

In this alternative during the first decade, prescribed site-preparation burning would be concentrated in 4,363 acres in pine regeneration areas, as shown in Table 3 - 79.

An average of 1,546 acres of prescribed understory burning per year would occur in upland hardwood and hardwood-pine stands for fuel reduction, and control of understory composition. At this level, a continued reduction in oak and pine regeneration is expected. Lack of prescribed burning could lead to fuel buildup that would allow the forest to be more heavily damaged by wildland fire (e.g., due to arson), negatively affecting timber quality.

CUMULATIVE EFFECTS

There would be no additional cumulative effects beyond those previously described as common to all alternatives.

HERITAGE RESOURCES

Affected Environment

The DBNF's Heritage program is about people. It's about those who share a heritage experience while visiting the forest and about those who have left a record of our nation's rich cultural heritage over the millennia. The Forest Service strives to preserve America's historical and cultural foundations to ensure future generations a genuine opportunity to appreciate and experience our heritage. The Forest is exceedingly rich in these non-renewable resources that represent over 13,000 years of people interacting with their environment. The record of those who came before us is held in over 3,800 archaeological sites that have been documented on the DBNF with thousands more remaining to be recorded. These sites range from prehistoric camps and rock art to pioneer trails, Civil War battlefields, farmsteads, coal towns, and iron furnaces. Each one of these sites is a valuable part of the diverse mosaic that portrays the story of those who preceded us. An overview of DBNF heritage resources was prepared in 1982. Since the majority of known sites to exist have been recorded since the publication of that overview, a major update is needed.

The Forest's heritage resources are non-renewable and continue to grow in importance. They are increasingly threatened by development, public use, and vandalism. Much evidence of the past, such as artifacts and architecture, is extremely fragile and can be obliterated by relatively minor modifications of the ground surface. The damage is frequently subtle and inconspicuous and often can only be recognized by a professional or trained person. Increasing public use of the outdoors and intensified development of Forest managed lands increase the probability that heritage sites may be damaged or lost.

The primary mission of the Forest's Heritage Program is to administer the heritage resources in a spirit of stewardship for the inspiration and benefit of present and future generations. Therefore, the goals of the Heritage Program are basically threefold:

1) To locate the historic and prehistoric heritage resources within the Forest's boundaries,
2) To determine the eligibility of these resources for inclusion on the National Register of Historic Places (National Register),
3) To preserve and protect those resources.

Inventory is the first task required since it defines the database on which all other heritage management tasks depend. The level of inventory is primarily driven by other resource needs. By 2001, a total of 241,575 acres of the Forest had been inventoried resulting in the documentation of 3,840 heritage resource sites. Over the last 10 years, the DBNF has inventoried an average of 6,200 acres per year. Based on these figures, a complete inventory of the Forest will require approximately 75 years.

Also based on the current figures, the Forest likely contains over 11,000 heritage resource sites of which 4,500 will be considered eligible for listing on the National Register. The National Register helps record the story of our nation. It is a roster of important links to our past and a list of historic distinction that identifies properties worthy of preserving. The Forest Service is mandated to nominate historic properties (both historic and prehistoric) to the National Register. Of the 3,840 heritage resource sites that are currently documented on the DBNF, 1,549 are listed or considered potentially eligible for listing on National Register. The Forest currently evaluates an average of five sites per year to determine whether their qualities or character qualify them as eligible for inclusion on the National Register. If this trend continues, the Forest will need approximately 900 years to evaluate all properties for National Register eligibility.

The Forest is also required to establish and maintain government-to-government relations with federally recognized tribes having an interest in the Forest's land base and resources, in accordance with the Presidential Memorandum on Government-to-Government Relations with Native American Tribal Governments (1994). The DBNF must also consult with federally recognized Native American tribes having geographic or cultural ties to National Forest System land on proposed actions that may affect sites or areas of special significance to those tribes. Such consultations are are required by the Archaeological Resources Protection Act, American Indian Religious Freedom Act, National Historic Preservation Act (NHPA), Native American Graves Protection and Repatriation Act as well as the Presidential Memorandum on Government-to-Government Relations.

Heritage resources are recognized as fragile and irreplaceable with potential public, scientific and religious uses, representing an important and integral part of our nation's heritage. The affected environment are those heritage resources that meet the criteria of eligibility for listing on the National Register of Historic Places, Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on heritage resources that are listed in or eligible for inclusion in the National Register. "Undertaking" is a term with legal definition and application (see 36 CFR 800.2) that includes any activities or programs which could have an effect on heritage properties, known or not, federal or not. An effect, whether it is beneficial or adverse, is any change in the character that would qualify the resource for the National Register. An undertaking has an adverse effect on a heritage property under conditions that include but are not limited to:

1) Destruction or alteration of all or part of a property
2) Isolation from or alteration of its surrounding environment
3) Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting
4) Transfer or sale of a Federally owned property without adequate conditions or restriction regarding preservation, maintenance or use
5) Neglect of a property resulting in its deterioration or restriction.

Decisions regarding planned management undertakings on the DBNF are preceded by heritage resource inventories of the proposed area of potential effect and consultation with the State Historic Preservation Officer (SHPO), as directed by Section 106 of the National Historic Preservation Act. In consultation with the SHPO, the Forest must consider the full range of impacts, both those that will be direct results and those that could be indirect consequences of the action. The results of the inventories are used to develop measures to safeguard those heritage resources listed on or eligible for listing on the National Register. Direct effects could result from both natural and human-caused events such as:

1) Soil disturbance to varying depths
2) Soil compaction or rutting
3) Changes in soil chemical composition
4) Inundation
5) Introduction of intrusive elements (non-compatible visual or auditory components)
6) Neglect
7) Diminished jurisdiction, as in the case of a land exchange.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Decisions about planned management undertakings on the Daniel Boone National Forest are preceded by heritage resource inventories of the proposed area of potential effect, and consultation with the State Historic Preservation Officer (SHPO) as directed by Section 106 of the National Historic Preservation Act. Regardless of alternative chosen, all projects implemented under the 2004 Forest Plan will be designed to avoid adversely affecting significant heritage resources.

Impacts on heritage resources would be similar in all alternatives as well as the impacts of cultural resource management on other resources. The difference will be the probability rate of occurrence, which is based on the amount of ground-disturbing activity that is carried out in each alternative and the number of people visiting the Forest. Road construction, utility rights-of-way construction, and fire suppression may adversely affect cultural and historical sites. Fire could expose cultural sites, which may indirectly increase vandalism of sites or may destroy historical sites. Discovery of a significant cultural resource site may delay or cancel road construction, utility rights-of-way construction, vegetation management, or land exchanges.

Effects of Vegetation Management

Vegetation management may result in beneficial as well adverse effects to heritage resources. Adverse effects may result from undertakings such as the harvest or manipulation of timber. Unknown resources can be disturbed by heavy machinery and vehicles crossing a site, where logs are skidded across a site, when erosion is caused by removal or disruption of the vegetation cover, or due to increased soil exposure. Heritage resources may benefit from vegetation management as well. For example, protective management for the white haired goldenrod will complement the protection of heritage resources located in rockshelter settings.

Effects of Wildlife Management

Wildlife management activities may cause adverse effects to heritage resources. Direct effects may result from undertakings such as wildlife pond construction that can destroy unknown sites. Soil disturbance of grassy openings can directly affect heritage resources by damaging or breaking artifacts. Increased surface visibility may result in the unauthorized collection of surface artifacts or the excavation of subsurface material. Access corridors necessary to maintain grassy openings or to construct water sources and vernal pools may encourage site vandalism or looting due to the increased availability of easy access.

Effects of Minerals Management

Both minerals exploration and subsequent extraction can affect heritage sites. Exploring for minerals such as oil and gas may produce impacts within the area of a drill pad or within a transportation corridor to access the drill site. Although the impact zone is localized, the amount of ground disturbance is severe. Extraction of oil and gas would involve connecting pipeline rights-of-way and access roads over an extended area of the Forest that could impact heritage sites. While the extraction of coal is by deep mining methods, there is still the potential for heritage sites to be impacted by surface subsidence.

Effects of Transportation Management

Road construction may totally impact unknown heritage resources. Disturbance within a construction corridor may remove all soil containing cultural deposits. An indirect effect of road construction is the increased accessibility to remote areas that can lead to site looting. Site looting has been directly connected to increased accessibility. Although the majority of direct effects to heritage sites occur during the initial construction of a road, maintenance or reconstruction of an existing road may also impact heritage when drainage ditches are cleaned or modified or when roads are widened or straightened. Heritage sites situated on ridgetops appear to be the most vulnerable to impacts from road construction. For example, 27 of the sites documented in fiscal year 1995 had been adversely affected by road construction activities (Ison 1995).

Effects of Land Management

Exchange of federal land containing heritage resources to a non-federal agency or private ownership would be considered an adverse effect. This is because protection under federal law would no longer apply to the heritage resources contained within the exchange. However, the acquisition of land containing heritage resources by the Forest through exchange or purchase would be beneficial since the resource would be protected under federal law.

Effects of Fire Management

High-temperature wildland fire could damage surface or shallow archaeological site, standing structures, cemetery markers or rock art sites. Sites of the historic period are most subject to damage because many of these properties contain flammable artifacts such as wooden structures located at or near the surface. Other types of artifacts can also be damage by hot fires. Glass artifacts can be melted and ceramics can be “crazed” or “pot-lidded.” The construction of firelines, especially dozer-constructed firelines could severely impact or destroy heritage sites. Mop-up operations could also impact heritage sites. Erosion from water hoses or earth disturbances such as the digging out of burning roots or stumps can damage or destroy archaeological deposits contained in the soil. Under normal conditions heritage surveys do not precede emergency fire line construction or mop-up activities, thus there is high potential for damage to unknown properties. Prescribed fire could also damage heritage sites in the same manner.

Effects may include erosion loss due to burned vegetation cover or further deterioration of artifacts following damage by high temperatures.

Effects of Recreation Management

Recreational activities may affect heritage resources in various ways. Some trails lead to or pass by archaeological sites. Archaeological sites are extremely vulnerable to damage from the increased number of visitors to the forest. Adverse effects can result from the uncontrolled movement of people across the archaeological deposits. Types of damage range from soil erosion and subsequent damage or loss of buried artifacts and features to artifact breakage and displacement as a result of trampling. The use of trails may negatively impact heritage sites by increasing visitor traffic to sensitive areas. Off-highway vehicle or horse traffic may increase erosion where trails pass through heritage sites. Backcountry camping can contaminate archaeological deposits with modern materials and charcoal severely limiting their scientific potential. Displacing artifacts from their context by clearing campgrounds can diminish the integrity of heritage sites. Activities associated with rock climbing can impact heritage resources in various ways. The primary impacts of this activity are from foot traffic that result in erosion and compaction on deposits within rockshelter sites. The use of chalk can cause a visual problem for other visitors to heritage sites located in rockshelters. In general, impacts from recreation and public use result from increasing human access to an area. The steadily increasing demand for outdoor recreation has resulted in increased impacts to heritage resources. For example, a recent sample survey within the Red River Gorge revealed that 62 percent of the archaeological sites visited had recognizable impacts and 84 percent of the prehistoric cultural components considered eligible or potentially eligible for listing on the National Register have been impacted.

Effects are often unnoticed by the casual observer but develop into greater problems. For example, user-developed trails lead visitors unknowingly to areas that may contain sensitive resources and the increased access could increase the threat for archaeological site damage. Studies have shown a link between ease of access and the occurrence of site looting. Site looting is considered the greatest threat to the archaeological resources located on the Forest. In 1996, 25 archaeological sites, including 5 listed on the National Register were revisited to assess their condition. Nearly one-fourth of all the sites including three of the 5 sites listed on the National Register had suffered additional damage from looting. Six of the 25 sites that were revisited showed an additional loss of between 5 and 30 percent of the remaining intact cultural deposits from continued looting.

CUMULATIVE EFFECTS

Requests from private parties and governments for the use of the National Forest System lands may accelerate the number of inventoried acres for each alternative. The number and type of requests are not likely to change between alternatives.

The rate of site destruction on private land within the proclamation boundary may determine the significance level of sites within National Forest System lands.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Because the management activities that may affect heritage resources would remain at the current levels, the effects to known heritage resources would also remain the same. The degree of effects by undertaking projects to known heritage resources should remain slight because inventory, assessment, and mitigation measures would be implemented prior to management action. However, protection measures for known sites would remain inadequate. A full inventory of the Forest would be completed in approximately 75 years.

CUMULATIVE EFFECTS

None beyond those previously described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

The degree of effects by undertaking projects to known heritage resources should remain slight because inventory, assessment, and mitigation measures would be implemented prior to management action. The inventory of the Forest for heritage resources would take much longer under this alternative because the majority of inventories would be conducted in conjunction with other projects. A full inventory would not be accomplished for approximately 370 years. Protection measures would remain the same.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

The degree of effects by undertaking projects to known heritage resources should remain slight because inventory, assessment, and mitigation measures would be implemented prior to management action. A full inventory would not be accomplished for approximately 73 years.

CUMULATIVE EFFECTS

None beyond those previously described.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

The degree of effects by undertaking projects to known heritage resources should remain slight because inventory, assessment and mitigation measures are implemented prior to management action. However, the emphasis on recreational opportunities may create special problems resulting from more people visiting the Forest. A full inventory would not be accomplished for approximately 73 years.

CUMULATIVE EFFECTS

None beyond those previously described.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

The degree of effects by undertaking projects to known heritage resources should remain slight because inventory, assessment and mitigation measures are implemented prior to management action. However, this alternative would pose a risk to both known and unknown heritage resources as a result of the increased numbers of people visiting the Forest. A full inventory would not be accomplished for approximately 73 years.

CUMULATIVE EFFECTS

None beyond those previously described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

The degree of effects by undertaking projects to known heritage resources should remain slight because inventory, assessment, and mitigation measures would be implemented prior to management action. A full inventory would not be accomplished for approximately 89 years.

CUMULATIVE EFFECTS

None beyond those previously described.

PRESCRIBED FIRE

Affected Environment

Daniel Boone National Forest has an active prescribed fire program, albeit small compared to the total acreage of the forest. A prescribed fire is "any fire ignited for management actions to meet specific objectives" (USDI and USDA Forest Service 1998). More specifically, it is the "controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions that allows the fire to be confined to a predetermined area, and produce the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives" (NWCG IOSWT 1996). The forest conducts burns to meet several objectives including ecosystem management. Much of the burning in the 1990s had been to restore particular fire-adapted habitats. Fire adapted communities include fire-mediated and fire-influenced communities. Fire-mediated communities are adapted to promote fire, but within community specific limits controlled in part by the nature of the vegetation within these communities and the physical position on the landscape they occupy. Fire drives both compositional and structure conditions within the community. Fire-influenced communities are adapted to limit the frequency and intensity of fires due the nature of vegetation and physical position on the landscape among other factors, but fire still occurs within them. Fire seldom if ever drives compositional and structural change in fire-influenced communities. Prescribed burning in these latter communities is often incidental to prescribed burning in fire-mediated communities.

Most of the prescribed burning conducted to date was to restore the fire-mediated, open, southern yellow pine forests and woodlands habitat for the now-extirpated red-cockaded woodpecker. In doing so, natural pine regeneration increased along with cover of native grass and herbaceous species, which had been effectively shaded out by a dense hardwood midstory following a history of fire exclusion. Prescribed fire has also been used to manage grassy openings, areas planted in grasses and/or forbs to provide habitat for a variety of animal species. A third objective has been site preparation: to remove logging slash and/or to decrease woody competition for planted seedlings or natural regeneration. Fuel reduction burns have been used to reduce logging slash, snags, dead and downed fuel resulting from insect infestations, thick litter, and overall, a preponderance of woody fuels that could increase the intensity of a wildland fire, a fourth objective. Heavy fuel loading can make suppression efforts more difficult, costly and dangerous. The 1985 Plan estimated that up to 15,000 acres would be prescribed burned annually. However, from 1992 to 2001, accomplishments ranged from 587 to 12,929 acres. Often, more than one objective is targeted during a prescribed burn.

Although lightning strikes and subsequent fires are uncommon in eastern Kentucky (Barden and Woods 1974, Ruffner and Abrams 1998), many plant communities are adapted to frequent fire resulting from thousands of years of anthropogenic burning (Abrams 1992, Buckner 1983, Denevan 1992, Van Lear and Waldrop 1989). Fire-mediated communities make up about 69 percent of the Daniel Boone National Forest, where they tend to be found on south and west slopes as well as ridge tops, in topographic positions that promote fire spread. These communities include dry-mesic oak forest; dry and xeric oak; xeric southern yellow pine and yellow pine-oak; and dry and dry-mesic oak-yellow pine forests. Rare communities such as glades and canebrakes are also fire-dependent (Brantley and Platt 2001).

Some community types, such as those described above, are more prone to burn because of topographic position, vegetation type or community structure. However, in the right season and under the right weather conditions, most if not all of the forest could burn, including mesic communities. In fact, in 1880, ten fires burned across 556,000 acres of forest across the state (Sargent 1884 in Ison 2000). Fires spread across dry-xeric fire-mediated communities; they also spread across mixed mesophytic forests. These latter forests are considered a fire-influenced: fire occasionally occurs in this type but does not play a large role in influencing the vegetation.

The fire-mediated forests of the eastern United States exist in a variety of forms and conditions. The majority of these have oak-dominated canopies, but some share dominance with southern yellow pines or hickories, and some are southern yellow pine-dominated. Except for the most extremely xeric sites on DBNF, where physiology of the species and edaphic characteristics of the sites may combine to create a relatively stable system, the presence or absence of oak and yellow pine is tied to disturbance regimes involving, in particular, fire, drought, windstorms, clearing (with subsequent regrowth), grazing and chestnut blight, all of which may act alone or in tandem with each other or with site conditions (Abrams 1992, Biocca et al. 1993, Edgin and Ebinger 1997, Stephenson and Fortney 1998, Rhoades 1999, Abrams 2000). Of these, fire appears to be the most important (Abrams 1992, Abrams 2000). Where pollen and/or charcoal records are preserved in pond or lake strata or other sites (Stephenson and Adams 1989, Abrams 1992, Delcourt and Delcourt 1997, Delcourt and Delcourt 1998, Delcourt et al. 1998), there is a strong correlation between increased burning events and the presence of oak and southern yellow pines. The increased burning is strongly correlated with known shifts in Native American culture from hunting/gathering societies to farming societies. Except for the Gulf and southern Atlantic coastal plains, lightning-set fires are limited in the eastern United States and cannot account for the evidence of fire history in old forests (Martin 1989, Abrams 1992, Delcourt and Delcourt 1998). On the other hand, in some systems, e.g., barrens and savannas[11], the absence of fire has actually increased oak at the expense of grassland or pine forest (Guyette and Cutter 1991, Abrams 1992, Robertson and Heikens 1994).

Across the eastern United States, including DBNF, oaks and yellow pines appear to be losing ground. Over most of the area between the Midwestern and coastal prairies and barrens/savannas, oak forests are reduced in abundance over historical levels. To the north, the non-native gypsy moth is behind the death or serious injury to a large expanse of oak forest due to defoliation induces oak decline. To the south oak wilt and possibly strains of chestnut blight also inflict damage on hardwoods. Also the south, particularly in Kentucky and Tennessee, the recent unprecedented outbreak of native southern pine beetle has decimated square miles of southern yellow pine trees. Underneath this aging and dying forest, oak seedlings may be found, but saplings are not common. Southern yellow pine seedlings are at least as rare. More often, species such as sugar maple, red maple, beech, hemlock and white pine are dominant in the seedling and sapling layers, or even dominant in the overstory (Anderson and Schwegman 1991, Abrams 1992, Farr and Tyndall 1992, Stephenson and Fortney 1998, Keller and Hix 1999, Van Lear et al 2000). Of these replacement species, red maple is the most widespread and opportunistic, and has greatly increased in importance in eastern forests over the last century (Abrams 1998). This species effectively competes with oak throughout the eastern United States, and may replace them (Abrams 2000).

There is little doubt that historical Native American fire-setting helped to shape the oak and yellow pine forests seen today in eastern North America, and that the use and disuse of fire by European

[11] Comparable in this document to wooded grasslands/shrublands

settlers (for example, Robertson and Heikens 1994) and their descendants continued the process and continues to do so today. Overall, the presence of fire in eastern forests has been reduced dramatically since the 1930s (Van Lear et al. 2000). Oaks and southern yellow pines are known to be intolerant of shade, and do not grow well even under the shade of overstory trees of the same species. In the denser shade of the competing species listed above, all of which are tolerant of shade, they fair worse. There is a real concern that present-day upland forests will be replaced by forests of more mesic and shade tolerant species, altering the character of much wildlife and plant habitat. Land managers are now struggling to maintain oak and southern yellow pine forests on the landscape. Fire appears to be the critical element missing in most cases, and it is fire that managers wish to return to these areas, thereby restoring woodlands and wooded grasslands/shrublands, as well.

Stands can be classified according to how far removed from the historical fire regime they are, and how high the risk of losing key ecosystem components is (Schmidt et al. 2002). In the southern Appalachians, changes from the historical fire regime tend to include less frequent, and possibly lower-intensity, fires than which occurred pre-settlement. Ecosystem losses include relatively gradual changes in canopy composition but also relatively rapid reduction in or losses of fire-dependent and/or shade-intolerant understory species. Rare species are the first to disappear (Stanturf et al. 2002), and "continent-wide loss or depauperization of the pyrophytic herb layer following 20th century fire suppression is one of the unrecognized ecological catastrophes of landscape history" (Frost 1998, p. 79). Packard (1993 in Wade et al. 2000) agrees that exclusion of fire from these forests should be considered "a catastrophic disturbance" (p. 74). However, on DBNF, changes to the fire regime also include more frequent fires that are set (by arsonists) under extreme weather conditions (e.g., dry, windy days) without regard to fire-inflicted injury on residual trees.

Fire Regime Condition Classes (Schmidt et al. 2002) are used by the federal land management agencies as a qualitative measure to describe the degree of departure from historical fire regimes, possibly resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, canopy closure and fuel loadings. The three classes, as defined for the conditions on DBNF are:

Condition Class 1: For the most part, fire regimes in this class are within historical ranges. Vegetation composition and structure are intact. Fire-dependent ecosystem components are maintained by desired fire regimes. On DBNF, this class is the smallest. It includes areas that have been within the prescribed burn program for the longest period, and which are exhibiting significant oak and southern yellow pine regeneration in the midstory plus a diversity of grasses and forbs in the understory, compared to unburned areas. It also includes mesic communities on north and east aspects, mid- to lower slope positions, coves, and concave topography, which are often fire-influenced, but none of which tend towards environmental conditions conducive to fire.

Condition Class 2: Fire regimes on these lands have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands. On DBNF these are areas that have been introduced to the prescribed burn program most recently and/or exhibit sufficient oak and southern yellow pine regeneration, at least as seedlings. It also includes areas that may have been subjected to wildland fire but not so frequently that oak and southern yellow pine regeneration is negated.

Condition Class 3: Fire regimes on these lands have been significantly altered from their historical return interval. Fire frequencies have departed from historical ranges by multiple return intervals. The risk of losing key ecosystem components from wildland fire or the lack of anthropogenic fire is high. Vegetation composition, structure and diversity have been significantly altered. Consequently, these lands verge on the greatest risk of ecological collapse. Because eastern oak, and to some extent southern yellow pine, forests are so resilient, they can survive an extended period without fire (Stanturf et al. 2002): they will still produce seed that can germinate when conditions become favorable. However, once the overstory dies (e.g., from disease, repeated insect attacks or extreme weather events), only seedlings or the seed bank may exist to perpetuate the stand. Currently on DBNF, the southern yellow pine forests are the most damaged by recent ice storms and southern pine beetle infestations. Oak forests have been damaged by ice storms as well, and are in line to be influenced by gypsy moth infestations. Gypsy moth damage maybe more severe in oak stands already impacted by such factors as ice storms, low rainfall and poor soils. Because of the changes in the historic fire regime and other changes in management practices, it could be argued that a large portion of DBNF is in Condition Class 3.

The landscape that burned in previous centuries (by lightning or humans) is now greatly altered. Roads, agricultural areas and developments have created firebreaks not previously known in forest communities. Whereas historic fires tended to burn until rain or a large natural barrier was encountered, modern prescribed fires are conducted in blocks ranging from less than 100 to a few thousand acres. Also, the pattern of human development affects when and where prescribed burns can be conducted. The relative location of hospitals, nursing homes, subdivisions, cities, and highways to National Forest System lands influence the prescribed burning program. Smaller or isolated tracts, or areas with difficult terrain on which to build fireline, may not be as likely to be included in the burn schedule, either. Otherwise, virtually all of DBNF's land base could be prescribed burned under some weather pattern.

The affected environment for this analysis is National Forest System lands on the DBNF.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Fire has been a driving force in this forest's ecosystem for thousands of years and as such, many species and communities are fire-adapted. They have evolved to survive fire and some even require it for successful reproduction or a competitive advantage. Fire provides habitat, directly and indirectly, that is essential to some species' viability (Komarek 1974).

Prescribed fires are fires ignited by management to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition (USDI and USDA Forest Service 1998). Prescribed fires have been used for decades for fuels reduction, to reduce the risk of destructive wildland fire (Van Lear and Waldrop 1987). More recently managers have used them as a tool to influence vegetation, often mimicking historic fire regimes. They are ignited under specific weather conditions and ignition methods so that impacts to vegetation and other resources are predictable.

Native Americans used fire as a primary tool to keep the grasslands, savannas and forests productive, as well as to simplify travel and to clear land for gardens. Landscapes could have burned regularly, sometimes annually, in some areas (Barden 1997; Waldrop et al. 1987, Langdon 1981 and Leyburn 1962 in Van Lear and Waldroup 1989; Pyne 1983; also see summary in Brown 2000). However, long before Euro-Americans settled Kentucky, Native American burning decreased drastically (Brown 2000, Buckner 1989, Hamel and Buckner 1988). Because of a lack of resistance to European diseases, tribes were decimated by even minimal encounters with whites. Both grasslands and wooded areas began moving toward late-successional forests with a preponderance of fire-intolerant species, until settlers arrived, resumed burning, and once again reversed succession (Van Lear and Waldroup 1989). However, since the time of, or before, land acquisition by the Forest Service, fire has been excluded once again from much of the east (Pyne 1982 in Van Lear and Waldrop 1989).

To restore fire as a positive disturbance mechanism on the forest ("restoration burns"), any area initially likely needs to be prescribed burned frequently: every three years or possibly more often. Season of burn, fire intensity, level of canopy shade, density of fire-intolerant species (Van Lear and Waldrop 1989), sprouting capabilities and tree thinning rates are all factors that will influence the rate of change in species and composition across the landscape. There has been little long-term research that has focused on all of these factors; thus, there are many unknowns with regard to restoration fire regimes, particularly within hardwood stands (Stanturf et al. 2002, Van Lear and Waldrop 1989, Frost 1998). Adaptive management will play a critical role in the prescribed burning program in this forest and other land management units across the southern Appalachians.

As the landscape moves toward the desired future condition, prescribed fire would be reapplied less often, allowing oaks, pines, hickories and other desirable species to develop. Periodic fire will continue to be necessary to maintain the species composition and structure ("maintenance burns"). Current research suggests that historic return intervals ranged from less than 10 years (Cutter and Guyette 1994 in Stanturf et al. 2002; Dellinger 2000; Frost 1998; Emmons 1860, Hoffman 1994 and Frost 1995 in Frost 1998; Stanturf et al. 2002; Wade et al. 2000; also see summary in Wade et al. 2000), to as long as 35 years, depending on community type, and therefore, eventually, this will be the maintenance return interval. As the program continues, more acreage could be burned per year because, although more burn units will have entered into the burn cycle, the fire return interval on a particular landscape eventually is lengthened.

Fire is necessary in the upland oak and southern yellow pine systems to prevent natural succession that, in the absence of disturbance, leads to overstory dominance by fire intolerant species including red maple, other hardwoods, white pine or possibly hemlock. Southern yellow pines may be succeeded first by oaks, then other species (Stanturf et al. 2002; Wade and Lunsford 1989 in Stanturf et al. 2002). Without disturbance, oaks and southern yellow pine seedlings may be shaded out, with few surviving into the overstory, to the extent that stands of these types will not be perpetuated. Additionally, fire exclusion can create overstocking by fire-intolerant species to the level that trees must compete for limited resources. Trees thus become more susceptible to insect and disease outbreaks. Understory forb and grass layers in these systems are often depauperate or non-existent due to heavy shading or competition from shade-tolerant species such as rhododendron and hemlock. Another result of fire exclusion is the decreasing inflammability of the forest overall, at least during the period during which the individuals within it remain healthy. Increased density of trees and subsequent shading corresponds to less drying of fuels and less wind penetration within the stand to carry the fire (Benson 2000, Stanturf et al. 2002). Plus, fire-intolerant hardwoods tend to resprout many times after being top-killed, leading to the need for many burning repetitions. Therefore, restoration becomes increasingly difficult and costly.

Prescribed fire is also a tool to reduce hazardous woody fuels. Recent ice and snow storms, and southern pine beetle infestations, have greatly increased the amount of woody fuel on the ground, resulting in as much as 17-40 tons per acre in the areas most heavily impacted (USDA 2000). Tree tops and sometimes entire stands of hardwoods have been killed by the storms, and nearly all of the southern yellow pine stands on the forest have been killed or severely degraded, and are subsequently toppling. The high level of damage caused by these events may be caused partly by the stress resulting from the increased density of mid-canopy and canopy trees within today's forests compared to levels pre-fire exclusion. Until these snags and downed logs absorb moisture and decompose, wildland fire intensity in these areas could be greater than normal, and prescribed fires will be more difficult to execute.

High-intensity wildland fires result in undesirable effects. Live overstory trees can be injured or killed. Severe fires are more likely to cause temporary soil sterilization and sedimentation. They also are much more difficult to control, and fuel build-up around residences and other structures can lead to the loss of property. Management-ignited fires, with their intensity controlled by weather-, ignition-, and other parameters listed in the prescription, minimize damage to live trees, soils and structures.

Even without levels of fuels elevated over historic levels, fuel reduction burns are utilized to minimize the effects of future wildland fires -- both to the natural resources and to the human environment. Fuel reduction is a safety issue, as well. Total acres of fuel reduction burns needed over the planning period are partially dependent on weather and resultant rates of fuel decay. During wet years, wood, litter and duff will be less likely to burn and will decay more quickly.

Fire use will influence air quality. [Air quality is discussed separately.]

CUMULATIVE EFFECTS

Currently, and in the foreseeable future, private forest landowners will rarely use prescribed burning as a management tool. Kentucky state law prohibits open burning from February 15-April 30 and October 1-December 15 in or within 150 feet of any woodland or brushland, except between the hours of 6:00 p.m. and 6:00 a.m. or when the ground is covered with snow. This law ensures that, during the seasons (spring before leaf-out and autumn after leaf-drop) and time of day (afternoon) when a fire is most likely to burn under a forest canopy, ignition is illegal.

Within the proclamation boundary, Beech Creek State Wildlife Management Area and Big South Fork National River and Recreation Area intend to conduct prescribed burns, though at minimal levels. Beech Creek State WMA might burn grasslands, while Big South Fork NRRA plans to burn 75-100 acres (of mostly shrubland) yearly (Frank Graham 2002).

Although the Forest Service land base in eastern Kentucky is nearly 700,000 acres, the areas that are chosen for fire-mediated habitat restoration are greatly limited by location and types of development within and adjacent to the proclamation boundary. Prescribed fires can be conducted only if prevailing winds will prevent heavy smoke from traveling across or settling into "smoke-sensitive areas." These areas include major roadways, hospitals, nursing homes, subdivisions and cities. Four major highways cross DBNF: I-75, I-64, U.S. 27 and Mountain Parkway. Development around these corridors is increasing, and as a result, more restrictions will be placed on when and where prescribed fires can be conducted.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Under the 1985 Plan as amended, prescribed fire would be used for fuel reduction and ecosystem management. About 15,000 acres would be prescribed burned yearly, most likely within Prescription 4.A., Timber Production Management Area. Much of the ecosystem management emphasis would be within previous or existing southern yellow pine stands, restoring habitat for the currently extirpated red-cockaded woodpeckers.

Very little southern yellow pine or southern yellow pine-oak habitat exists on DBNF currently, as a result of recent widespread pine death beginning in 1999. Many species on the forest depend on this habitat in part or entirely, and at present, the likelihood of these species to remain viable is low or reduced. To restore this habitat, southern yellow pines must be planted on a large scale. The planting areas would first be subjected to a site preparation burn to minimize woody competition for the seedlings. Most likely they would not be treated with prescribed fire again during the planning period. Restoration would be a lengthy process, dependent upon the maturation of the pine stands. Pine woodlands would be considered in maintenance stage at age 70; pine grasslands and pine shrublands at age 80; and pine forest at age 90.

In Alternative A, southern yellow pine seedlings would be planted at a much more rapid rate that they would be under other alternatives. According to Spectrum, over 2,000 acres of southern yellow pine seedlings would be planted yearly during the first planning period. Eventually, at least 30,000 acres of future open, fire-mediated pine habitat would be restored.

Fire-mediated habitat would continue moving toward Condition Classes 2 and 3 unless prescribed burned regularly.

Table 3 - 82. Acres of yearly ecosystem management and fuel reduction by prescribed burning objective during the first decade, Alternatives A, B-1 and E-1.

Primary prescribed burning objective	Alt. A	Alt. B-1	Alt. E-1
Yellow pine reforestation (site preparation before planting)	2,083	436	436
Restoration of hardwood or mixed woodland, and wooded grassland/ wooded shrubland[1] (first application of fire)	0	395	395
Understory burn for maintenance of existing fire-mediated habitat (second application of fire or later) and/or fuel reduction[2]	12,917	1,546	1,546
Total per year	15,000	2,377	2,377

[1]About 81% of the restoration will be for woodlands and the remaining 19% will be for wooded grasslands/shrublands.

[2]Remainder of acreage after other categories is summed.

CUMULATIVE EFFECTS

None other than those discussed above.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Under this Alternative, prescribed fire would be used only to provide habitat for the viability of fire-mediated PETS species as necessary by law (Table 3 - 83), or for fuels reduction for safety purposes. During this planning period, about 2,400 acres would be prescribed burned annually for habitat restoration or maintenance (Table 3 - 82). Most of the forest's 100,000 acres of southern yellow pine forests would succeed to hardwoods, because prescribed fire would restore and maintain less than 40,000 acres of former southern yellow pine communities for viability purposes. Upland oaks would also succeed to fire-intolerant hardwoods, because fire appears to perpetuate oak advanced regeneration as well. Oak that has not been burned may also be more susceptible to oak decline, because of the crowded nature of the dense, unburned stands. These communities would continue to shift to Condition Class 2, and then Condition Class 3, unless prescribed burned on a regular basis.

Table 3 - 83. Minimum long-term objectives, in acres, of fire-mediated habitat restoration or maintenance for viability species.

Habitat type	Minimum acres
Yellow pine forest, mixed age[1]	33,000
Mature forest, open understory[2]	2,000
Thinned forest[2]	1,750
Hardwood or mixed woodland, wooded grassland/shrubland[2]	2,720
Minimum restored during planning period[2]	6470
Minimum restored within 8 decades	39,470

[1]Pine types will reach maintenance stage after 80 years.

[2]Hardwood types should be restored, and 4363 acres of yellow pine planted, during this planning period (10 years).

ALTERNATIVE C, C-1, AND D

DIRECT AND INDIRECT EFFECTS

These alternatives attempt to restore and maintain much more (Table 3 - 84) of the prescribed fire-maintained habitat than the approximately 40,000 acres required for viability (Table 3 - 83). The long-term objective, to be accomplished over the next 80 years, is to restore and maintain between 120,000-160,000 acres of fire-mediated habitat. More of the forest would shift to Condition Class 1 over time, in any of these three alternatives, than would shift in the remaining alternatives. Therefore, with regard to fire's historic role in maintaining healthy oak and southern yellow pine communities, Alternative C, C-1 or D would most benefit the forest.

Most of the prescribed burning would take place within Prescription 1.K., Habitat Diversity Management Area. Objectives for this area include the creation and maintenance of pine and mixed and hardwood forest, woodland, and wooded grassland/shrubland, providing a landscape reminiscent of pre-settlement times, and a fire regime similar to that installed by Native Americans, and later adopted by early settlers. Most of DBNF has been excluded from fire for 70 years or more. During this time, succession has advanced such that fire-intolerant tree species have gained a significant foothold across the landscape, even on dry slopes and ridgetops. If fire were the only tool used to restore these communities, it would take literally longer than a lifetime. Thinning would be incorporated to shorten the restoration time frame. Complete restoration of southern yellow pine and mixed pine-oak communities would still be partially dependent on the re-creation of the pine community; i.e., planting of shortleaf pines. Fifty percent or more of the 1.K Habitat Diversity Prescription Area would eventually be under a burning regime. This area would provide more than adequate habitat for species utilizing fire-mediated communities.

In any of the three alternatives, approximately 822 acres of pine would be planted per year over the next ten years, to begin restoration of the upland pine community. Southern yellow pine habitat is required for viability purposes at much higher acreage levels than fire-maintained, upland oak communities. The minimum required habitat restoration for hardwood/mixed woodland, wooded grassland/shrubland, mature forest and thinned forest (all fire-mediated) could be accomplished within this planning period. Because of the lack of mature yellow pines, these communities would be moved by default toward oak communities to meet the minimum viability acreage requirements. Once pines were re-established on DBNF, up to 700 acres in mature forest and up to 875 acres in thinned forest could be "pushed" to pine communities, and viability requirements would still be met.

Prescribed fire would be used as a primary tool to restore upland communities. Thinning could be used to expedite the restoration process. In the hardwood areas, and the remaining hardwood-pine areas, repetitive fires will open the canopy, allowing oak and pine regeneration. Thinning combined with burning will reduce midstory and/or overstory more quickly, thus restoring the upland communities more quickly. This combination of methods will be especially beneficial when re-creating low basal area oak and southern yellow pine woodlands, wooded grasslands and wooded shrublands. The removal of larger sub-canopy or canopy trees (particularly shade-tolerant species invading upland sites) by mechanical means, versus attempting to kill them with repeated fires, allows the transformation from overstocked forests to occur more quickly, thus benefiting the species requiring open upland habitat.

Over the planning period, it should be possible to increase the yearly average number of acres prescribed burned. As the vegetation structure within hardwood communities changes from a closed canopy with minimal fine fuel in the understory, to an open wood with a grassy understory, prescribed fires will take less time. Also, with time, less new firelines will need to be built, and more time can be devoted to burning. When the prescribed burn regime moves from restoration to maintenance, each location will require fire less frequently, allowing more acres to be entered into the program. Therefore, over the planning period, it is anticipated that more controlled fire can be applied every year.

Table 3 - 84. Acres of yearly ecosystem management and fuel reduction prescribed burning per year, Alternatives C, C-1 and D.

Type of burn	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Site preparation prior to planting for southern yellow pine reforestation	822	822	822	822	822	822	822	822	822	822
Restoration of hardwood or mixed woodland, wooded grassland and wooded shrubland										
Wooded grassland/shrubland	886	1,122	1,359	1,595	1,831	2,067	2,304	2,540	2,776	2,953
Hardwood or mixed woodland	3,775	4,782	5,788	6,795	7,802	8,808	9,815	10,822	11,828	12,583
Subtotal of restoration burns	4,661	5,904	7,147	8,390	9,633	10,876	12,119	13,362	14,604	15,537
Understory burn for maintenance of existing fire-mediated habitat and fuel reduction*	9,517	12,274	15,031	17,788	20,545	23,302	26,059	28,816	31,574	33,641
Objective per year	15,000	19,000	23,000	27,000	31,000	35,000	39,000	43,000	47,000	50,000
Anticipated range per year	7,500	9,500	11,500	13,500	15,500	17,500	19,500	21,500	23,500	25,000
	22,500	28,500	34,500	40,500	46,500	50,000	50,000	50,000	50,000	50,000

*This acreage is the remainder after site preparation and restoration burn objectives.

In Alternative D, prescribed burns would be oriented such that most burn units would be some distance away from most of the developed recreation areas to minimize visitor contact with the visual effects of fire: perceived as “ugly” by some (Buckner 1989). This added constraint could eliminate from consideration some acres of fire-mediated habitat. These acres have not been mapped or calculated.

CUMULATIVE EFFECTS

None other than those discussed above.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Under this Alternative, prescribed fire would be used minimally (Table 3 - 82) only to provide habitat for the viability of fire-mediated PETS species as necessary by law (Table 3 - 83), or for fuels reduction for safety purposes.

Nearly 350,000 acres of DBNF will be placed into the 4.A. Timber Production Emphasis Prescription Area. This area would be managed for the sustained production of high-value sawtimber. Shade-intolerant and mid-tolerant species would become dominant. Most of the forest's 100,000 acres with a southern yellow pine component would succeed to hardwoods, because prescribed fire would be minimized. Because fire appears to perpetuate upland oaks via advanced regeneration, they would also succeed to other hardwoods. Oak stands that have not been burned may be more susceptible to oak decline, because of the crowded nature of the dense, unburned stands. These communities would continue shifting to Condition Classes 2 and 3, unless prescribed burned on a regular basis. Prescribed burning would be minimized because of concerns about fire-induced damage. Much of the research which has indicated that fire damages merchantable timber has been gathered from wildland fire sites (Buckner 1989, Van Lear and Waldrop 1989); however, other research has reported bole damage caused by prescribed burning under certain conditions (Wendel and Smith 1986 in Van Lear and Waldrop 1989). Regardless of ignition source, damage to each tree varies by diameter and species-associated fire tolerance; not all trees are scarred by any single fire (Melton 2002; Kilgore and Taylor 1979, Stetnam et al. 1988 and Caprio and Swetnam 1995, all in Frost 1998; Sanders et al, 1987 in Stanturf et al. 2002). Conversely, fuels reduction burns prevent damage caused by intense or severe wildland fires.

CUMULATIVE EFFECTS

None other than those discussed above.

WILDLAND FIRE

Affected Environment

Wildland is any area with essentially no development, except for roads, railroads, power lines, and similar transportation facilities; structures, if they exist, are widely scattered (NWCG IOSWT 1996) In the eastern United States, and such areas may be relatively small. Regardless of size, any area with undeveloped vegetation is still defined as wildland. For fire management purposes, wildland is an area containing flammable natural fuels, such as leaf litter or logging slash. Fuels can be located at the line, area, or zone where structures and other human development meet or intermingle with them; this is called the wildland/urban interface (NWCG IOSWT 1996).

A wildland fire, then, is any non-structure fire, other than prescribed fire, that occurs on wildland. The term encompasses fires previously identified as “wildfires,” which require a suppression response, and “prescribed natural fires,” which are used to meet resource objectives. However, both of these terms are now obsolete (USDI and USDA Forest Service 1998) and the appropriate response to be taken by fire personnel cannot be discerned without additional information.

Wildfire was defined (by federal firefighting agencies, pre-1998), as an unwanted wildland fire (Hardy et al. 2001), or more specifically, a “fire occurring on wildland that is not meeting management objectives and thus requires a suppression response” (NWCG IOSWT 1996). They could be ignited by humans or by natural events such as lightning. It is now referred to as a wildland fire requiring a suppression response. Regardless of possible resource benefits, human-caused/non-management-ignited fire must be suppressed.

About 99 percent of wildland fires on the DBNF are human-caused (Table 3 - 85). Some are accidental starts, but by far most fires in this forest are intentional ignitions, known as arson fires. Somerset, Stearns, London and Redbird Ranger Districts in particular tend to have a high number of arson fires. Several reasons have been suggested for this behavior, including attempted eradication of ticks and snakes, boredom, anger toward or retaliation against neighbors, and hostility toward state or federal government. High arson rates weakly correlate with poverty levels (Prestemon 2002); eastern Kentucky in general is the poorest region of the state.

Table 3 - 85. Wildland fires by cause and size on the DBNF, 1992-2001.

Cause	Number of fires	% of fires	Acres	% by acreage
Lightning	12	1	280	<1
Arson	883	76	46,775	87
Debris burning	93	8	2,988	6
Campfires	66	6	1,029	2
Miscellaneous	64	5	2,218	4
Smoking	15	1	97	<1
Railroad	12	1	143	<1
Equipment use	10	1	144	<1
Children	9	1	31	<1
Totals	1,164	100	53,705	100
10-year average	116		5,370	

Variability in the number of ignitions and acres burned is influenced by weather patterns.

The forest is heavily laced with roads and trails, with small towns interspersed throughout. Private ownership is intermingled with federal ownership and overall, the areas are rural with low concentrations of houses surrounded by natural vegetation. Camping, hunting and ATV riding are popular both on- and off-forest. Some tracts may be more susceptible to wildland fire ignitions because of these activities.

Fires caused by lightening strikes, though uncommon in eastern Kentucky, can occur at any elevation or vegetation type. DBNF averages about one lightning fire per year (Table 3 - 85). Although human-caused wildland fires must be suppressed, National Forests have the option to use lightning-caused fires to benefit resources. The obsolete term prescribed natural fire (PNF) was used to describe “naturally-ignited [e.g., by lightning or volcanic activity] wildland fire burning under specified conditions where the fire was confined to a predetermined area and producing the fire behavior and fire characteristics to attain planned fire treatment and resource management objectives” (NWCG IOSWT 1996). A PNF did not require a suppression response, like a wildfire did. A PNF fire is now appropriately termed a wildland fire use fire[12].

Wildland fire use is a management response that must be pre-approved, before ignition, in the Fire Management Plan, thus allowing Ranger Districts to manage a lightning-caused fire as a “wildland fire use fire.” This designation means that it is burning under acceptable weather conditions and in a pre-approved geographic area (USDI and USDA Forest Service 1998). Managers monitor the fire, provided that it fits the same parameters required of a (human-ignited) prescribed fire, and allow it to burn until weather or a change in fuel loading leads to its extinction. However, this action can be taken only if a plan for that location has been prepared and approved, and only for as long as the fire continues to burn within acceptable predetermined parameters. Conversely, all human-caused wildland fires must be suppressed.

The affected environment for this analysis is National Forest System lands.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

All human (non-management)-ignited wildland fires (regardless of cause) must be suppressed, by law. Human-caused wildland fires are ignited without regard to the damage they may cause. Inappropriate seasonality, intensity or return interval, regardless of cause, can have negative effects on the ecosystem. Human-caused wildland fires often consume more litter and damage or kill more trees than a prescribed fire in the same area (e.g., fire running upslope on a dry, windy day) because weather or ignition patterns may be very different than those chosen for a prescribed fire. Lightning-caused fires must be suppressed if the forest Fire Management Plan (FMP) has not approved a prescription for that location, or when such fires are not burning under the specified conditions outlined in the FMP. [Wildland fire use fires are discussed separately.]

[12] The term “wildland fire use fire” should not be confused with “wildland fire use,” a broader term encompassing the combination of wildland fire use and prescribed fire application to meet resource objectives (USDI and USDA Forest Service 1998).

Fire control efforts in emergency situations could adversely impact resources. Adverse effects could include sedimentation caused fireline construction, foot traffic on steep slopes, increased road traffic, application of fire retardants which could drift into waterways, drafting of large quantities of water, gas-powered pumps in water, and compounding of human impacts and soil compaction from fire camps. Other possible stream impacts include increased nutrients (which could also be a positive effect), and alteration of habitat from vehicles driving through the channel. Most visible is the degradation of habitat with up to 100 percent tree death, depending on the severity of the fire. Temporary soil sterilization could also occur. However, Standards within the Forest Plan, regardless of alternative chosen, should minimize negative effects resulting from suppression actions.

The number of acres burned per year by wildland fire has not remained constant over the past decade. Weather has been one influence on both the number of ignitions as well as acres burned. Additionally, the chosen alternative could affect the number of fires that are ignited, particularly those caused by escaped campfires and arson. This could be based on a variable level of access to the forest as well as public reaction to management decisions leading to arson fires in response (Table 3 - 86). There is no way to anticipate these levels. There is no method to predict how the pattern of human-caused wildland fires will differ among the alternatives.

Table 3 - 86. Wildland fire causes that can be correlated with DBNF management decisions*, 1992-2001.

Year	Arson	% Arson	Campfire escapes	% Campfire escapes	Other	% Other	Total wildfires	Total acres burned
2001	116	77	7	5	27	18	150	15,814
2000	95	76	4	3	26	21	125	12,426
1999	154	73	16	8	42	20	212	10,463
1998	66	70	11	12	17	18	94	1,426
1997	25	66	5	13	8	21	38	703
1996	56	80	2	3	12	17	70	1,117
1995	139	81	8	5	25	15	172	5,715
1994	136	77	7	4	33	19	176	4,611
1993	68	85	2	3	10	13	80	844
1992	28	60	4	9	15	32	47	586
10-year total	883	76	66	6	215	18	1164	53,705

Arson and campfire escapes are the two wildland fire causes most likely to be related to land management decisions. Arson ignition patterns are correlated with public reaction to some federal decisions; number of campfires (and subsequent escapes) is related to level of recreational use. Note that both the number of ignitions and acres burned are additionally influenced by weather patterns.

CUMULATIVE EFFECTS

The incremental effects of other federal, non-federal, or private actions do not change, regardless of alternative.

Arson fires occur in high frequency across eastern Kentucky, regardless of land ownership. Because of the fragmented ownership pattern, fires that ignite on National Forest System lands often spread to private land, or vice versa. Kentucky Division of Forestry (KDF) is responsible for most of the suppression of wildland fires on non-federal land. Five of the nine KDF districts overlap the DBNF proclamation boundary (Table 3 - 87). In 2000, nearly all the KDF-suppressed fires, and the acreage burned, were in these districts. Cumulatively, wildland fire, and arson fire especially, potentially damages over 100,000 acres yearly in eastern Kentucky. In 2000 and 2001, over 1,800 homes and businesses were threatened by fire across the state, and 78 structures were destroyed. Fire damage to soils, waterways and trees (particularly commercial stands) concerns government officials and public citizens alike. Smoke, regardless of ignition location, will affect a large area.

Table 3 - 87. Fires suppressed by Kentucky Division of Forestry (KDF) within selected districts, 2000*.

KDF district	DBNF ranger district(s) encompassed	# of KDF-suppressed fires	% of all KDF-suppressed fires	Acres	% of all KDF-suppressed fires
Northeastern	Morehead Stanton	210	13	5,354	4
Kentucky river	Stanton Redbird	287	18	29,313	22
Southeastern	London Stearns Redbird	397	26	63,302	47
South central	Somerset Stearns	124	8	4,442	3
Eastern	Redbird	338	22	28,027	21
	Total	1356	87	130,438	96

* These figures relate to total KDF District acreage. Source: Unpublished data, KDF.

ALTERNATIVE A

DIRECT AND INDIRECT AFFECTS

Wildland fire use fire would be an acceptable tool to meet resource management objectives because DBNF Fire Management Plan, which tiers to the FLMP, would allow wildland fire use fires. However, the necessary development of site-specific prescriptions would be a low priority because lightning strikes under current conditions rarely result in a detectable fire.

CUMULATIVE AFFECTS

None other than those discussed above.

ALTERNATIVES B-1, C-1, C, AND D

DIRECT AND INDIRECT AFFECTS

Wildland fire use fire would be an acceptable tool to meet resource management objectives because the DBNF Fire Management Plan, which tiers to the FLMP, would allow wildland fire use fires. As more of the dense, closed-canopy forest is restored to lower density, open forests, woodlands and wooded grassland/shrublands, lightning fires could become more common as well as increase in area because environmental conditions would be more conducive to their spread. Thus, the percent of wildland fires caused by lightning could increase over time.

CUMULATIVE AFFECTS

None other than those discussed above.

ALTERNATIVE E-1

DIRECT AND INDIRECT AFFECTS

Wildland fire use fire would not be an acceptable tool to meet resource management objectives.

CUMULATIVE AFFECTS

None other than those discussed above.

SCENERY

Affected Environment

Visitors cite the visual appeal of the Daniel Boone National Forest's landscape as one of its greatest attractions. To help maintain the Forest's visual appeal, the Forest Service uses the Scenery Management System (SMS) to inventory and classify landscape character as well as the visual effects of management activities. SMS succeeded the Visual Management System in 1996 and uses many of the same criteria to classify scenery and set scenic objectives. SMS also helps integrate aesthetic values with other biological, physical, and social/heritage resources in the planning process.

Scenic Classes, one component of the SMS, measure the relative importance of landscapes. During project planning, they help compare the value of scenery with the value of other resources. Scenic Classes are determined by combining the three classes of scenic attractiveness with the distance of the viewer from the landscape as well as the viewer's interest in the scenery. Scenic Classes range from 1 to 7. Generally, Scenic Classes 1 and 2 have high public value, Classes 3 to 5 have moderate value, and Classes 6 and 7 have low value. Only Classes 1 to 6 occur in the DBNF's current inventory.

The analysis area includes the DBNF as seen from outside National Forest System lands as well as from within.

The SMS is explained in more detail in Agricultural Handbook Number 701, Landscape Aesthetics. An inventory of Scenic Classes by Prescription Area is shown in Table 3 - 88.

Scenic Integrity Objectives (SIOs) were assigned to each Scenic Class as seen in Table 3 - 90.

Assignment of SIOs is based upon the Desired Future Condition of a Prescription Area. Scenic Integrity Levels were used to compare the differing effects of the six alternatives.

Table 3 - 88. Landscape character and inventoried acres for Scenic Classes 1 through 6 for prescription areas within the DBNF.

PRESCRIPTION AREA*	Landscape character	Inventoried acres by Scenic Class 1	2	3	4	5	6
1.A. Research Natural Areas	Natural evolving	4,961	0	0	0	0	0
1.C. Cliffline Community	Natural appearing	374	7,601	12,196	4,282	6,520	70,020
1.E. Riparian Corridor	Natural appearing	6,761	9,650	22,754	4,354	10,029	81,860
1.G. Rare Community	Natural appearing	0	510	490	0	0	0
1.I. Designated Old-Growth	Natural appearing	0	253	3,568	1,038	2,576	7,856
1.J. Significant Bat Caves	Natural appearing	125	169	652	273	552	3,778
1.K. Habitat Diversity Emphasis	Natural appearing	38	13,052	55,094	23,272	37,140	283,273
1.M. Custodial Area	Natural Appearing Moving to Natural Evolving	37	10,708	54,110	22,861	36,654	277,260
2.A. Clifty Wilderness	Natural evolving	12,646	0	0	0	0	0
2.B. Beaver Creek Wilderness	Natural evolving	4,791	0	0	0	0	0
2.C. Wilderness Study Area	Natural appearing	2,834					
3.A. Developed Recreation	Natural appearing with cultural nodes	3,700	0	0	0	0	0
3.B. Large Reservoirs	Natural appearing with cultural nodes	30,673	0	0	0	0	0
3.C.1. & 3. Red River National W&S River Segment	Natural evolving	683	0	0	0	0	0
3.C.2. Proposed W&S River: Marsh Creek- Wild River	Natural evolving	1,440	0	0	0	0	0
3.C.4. Proposed W&S River: Cumberland River, War Fork Creek, Rockcastle River - Scenic Rivers	Natural evolving, natural appearing, pastoral, historic	5,622	0	0	0	0	0
3.C.5. Proposed W&S River: Rock Creek & Marsh Creek Recreational Rivers	Natural appearing	274	5,910	0	0	0	0
3.E. Red River Gorge	Natural evolving, natural appearing, pastoral, historic	16,042	0	0	0	0	0
3.F. Natural Arch Scenic Area	Natural appearing	1,065	0	0	0	0	0
3.H.2. Ruffed Grouse Emphasis	Natural appearing	0	31	1,495	623	2,710	5,676
4.A. Timber Production Emphasis	Natural appearing	37	10,708	54,110	22,861	36,654	277,260
4.B. General Forest Area (1985 Plan)	Natural appearing	6,798	20,328	75,369	26,592	43,973	353,445
5.A. Communications Site	Cultural nodes usually in natural appearing settings	0	20	0	0	0	0
5.C. Source Water Protection	Natural appearing	0	3,671	2,672	782	1,366	10,982

*Acres in the Prescription Areas do not add up to total acres on the Forest because some prescriptions areas overlap.

The original Visual Management System resulted in an inventory of Scenic Objectives used to guide site-specific analysis of Forest management activities. These were called Visual Quality Objectives. The new Scenery Management System uses a similar inventory called Scenery Integrity Objectives.

The relationship of the two Objectives is shown in Table 3 - 89. The relationship between the Scenic Integrity Objective and the Inventoried Scenic Classes are listed by prescription area in Table 3 - 90.

Table 3 - 89. Objectives under the Scenery Management and Visual Management Systems.

Scenery Management System Scenic Integrity Objectives	Visual Management System Visual Quality Objectives
Very High (VH)	Preservation
High (H)	Retention
Moderate (M)	Partial retention
Low (L)	Modification
Very Low (VL)	Maximum modification

Table 3 - 90. Scenic Integrity Objectives (SIO) by Scenic Class within prescription areas.

		SIO[1] by Scenic Class					
Prescription Area	**Landscape Character**	**1**	**2**	**3**	**4**	**5**	**6**
1.A.Research Natural Areas	Natural evolving	VH	VH	VH	N/A	N/A	N/A
1.C.Cliffline Community	Natural appearing	H	H	H	H	H	H
1.E.Riparian Corridor	Natural appearing	H	H	H	H	H	H
1.G.Rare Community	Natural appearing	H	H	H	H	H	H
1.I.Designated Old-Growth	Natural appearing	H	H	M	M	M	L
1.J. Significant Bat Caves	Natural appearing	H	H	M	M	M	L
1.K.Habitat Diversity Emphasis	Natural appearing	H	M	L	L	L	L
1.M. Custodial area	Natural Appearing Moving to Natural Evolving	VH	VH	VH	VH	VH	H
2.A.Clifty Wilderness	Natural evolving	VH	VH	VH	VH	VH	VH
2.B.Beaver Creek Wilderness	Natural evolving	VH	VH	VH	VH	VH	VH
2.C. Wilderness Study Area	Natural appearing	VH	VH	VH	VH	VH	VH
3.A.Developed Recreation	Natural appearing with cultural nodes	H	M	M	M	M	N/A
3.B.Large Reservoirs	Natural appearing with cultural nodes	H	M	M	M	M	N/A
3.C.1. & 3. Red River National W&S River Segment	Natural evolving	VH	VH	VH	VH	VH	VH
3.C.2. Proposed W&S River: Marsh Creek-Wild River	Natural evolving	VH	VH	VH	VH	VH	VH
3.C.4. Proposed W&S River: Cumberland River, War Fork Creek, Rockcastle River- Scenic Rivers	Natural evolving, natural appearing, pastoral, historic	H	H	H	H	H	H
3.C.5. Proposed W&S River: Rock Creek and Marsh Creek Recreational Rivers	Natural appearing	H	H	M	M	M	M
3.E.Red River Gorge	Natural evolving, natural appearing, pastoral, historic	VH, H	H	M	M	M	M
3.F.Natural Arch Scenic Area	Natural appearing	VH	H	N/A	N/A	N/A	N/A
3.H.1. Ruffed Grouse Emphasis	Natural appearing	H	M	L	L	L	L
4.A. Timber Production Emphasis	Natural appearing	H	M	L	L	L	L
4.b. General Forest Area (1985 Plan)	Natural appearing	H	M	L	L	L	L
5.A.Communications Site	Cultural nodes usually in natural appearing settings	M	M	L	L	L	L
5.C.Source Water Protection	Natural appearing	H	M	M	L	L	L

[1]SIO codes: VH = Very High; H = High; M = Moderate; L = Low; VL = Very Low; N/A = Not Applicable

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

The following Prescription Areas are common to all alternatives.

Table 3 - 91. Scenic Integrity Objectives (SIO) acreage in prescription areas common to all alternatives.

PRESCRIPTION AREA	SIO[1]	Acres[2]
1.A. Research Natural Areas	H	496
1.C. Cliffline Community	H	100,994
1.J. Significant Bat Caves	H	294
	M	1,478
	L	3,777
2.A. Clifty Wilderness	VH	12,646
2.B. Beaver Creek Wilderness	VH	4,791
3.A. Developed Recreation	M	3,700
3.B. Large Reservoirs	H	30,673
3.C.1. & 3. Red River National W&S River Segment	VH	2,123
3.C.2. Proposed W&S River: Marsh Creek-Wild River	VH	1,244
3.C.4. Proposed W&S River: Cumberland River, War Fork Creek, Rockcastle River- Scenic Rivers	H	5,622
3.C.5. Proposed W&S River: Rock Creek and Marsh Creek Recreational Rivers	H	6,184
3.E. Red River Gorge	VH	16,042
3.F. Natural Arch Scenic Area	VH	1,065
5.A. Communications Sites	M	20
5.C. Source Water Protection	M	6,343
	L	13,130

[1]SIO codes: VH = Very High; H = High; M= Moderate; L = Low; VL = Very Low

[2]Acres are the same for each Forest Plan alternative.

Except for the developed recreation sites, there is very little activity planned within these prescriptions. Activities that do occur can be blended with the associated landscape to meet the Scenery Integrity Objectives.

CUMULATIVE EFFECTS

The Scenery Management Handbook provides guidance in classifying the scenery and recommending actions to protect the scenic character of the landscape. The scenic integrity of the landscape within view of the Forest may change and most likely be reduced to a lower level through development and management on private land. The changes on private land within the proclamation boundary may change the concern level within National Forest System lands. This change would be the same for all alternatives.

Requests from private parties and governments for the use of the National Forest System lands could lead to a change in scenic classes on the DBNF. The number and type of requests are not likely to change between alternatives, however.

Under all alternatives and in all prescription areas, the existing Scenic Integrity Objective should be attainable despite changes on adjacent private land. While the Scenic Integrity Objective may need to be revised based upon changes in adjacent lands, this should not vary between alternatives. Therefore, cumulative effects should remain constant among alternatives.

Table 3 - 92. Summary of DBNF activities that impact visual integrity, in acres, by alternative.

Activity	Al.t A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Two-aged harvest 15 BA	3,000	366	993	1,000	1,000	2,871
Wooded grassland/shrub restoration 15 BA	0	77	705	705	705	77
Woodland restoration 40 BA	0	350	1,483	1,483	1,483	361
Uneven-aged harvest	0	108	108	108	108	108
Acres burned	15,000	2,377	32,900	32,900	32,900	2,377
Total acres affected	18,000	3,277	36,189	36,195	36,196	5,793
Suitable acres	575,458	70,000	347,803	347,803	347,803	373,090
Percent of area affected	3.9%	8.8%	10.2%	10.2%	10.2%	1.6%
Miles of road constructed	35	9	56	56	56	67
Total suitable acres with Very High or High SIO1	107,286	644,908	233,330	233,330	233,330	233,077
Possibility of affecting an area with Very High to High SIO	Very Low	High	Low	Low	Low	Low

Acres of activity are average annual acres planned.

Table 3 - 93. Scenic Integrity Objective (SIO) acres in each prescription area by alternative.

Prescription Area[1]	SIO[2]	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
1.A. Research Natural Areas	H	496	496	496	496	496	496
1.C. Cliffline Community	H	100,994	100,994	100,994	100,994	100,994	100,994
1.E. Riparian Corridor	H	0	126,152	126,152	126,152	126,152	126,152
1.G. Rare Community	H	0	1,200	1,200	1,200	1,200	1,200
1.I. Designated Old-Growth	H	N/A	N/A	253	253	253	325
	M	0	0	7,182	7,182	7,182	0
	L	0	0	7,856	7,856	7,856	0
1.J. Significant Bat Caves	H	294	294	294	294	294	294
	M	1,478	1,478	1,478	1,478	1,478	1,478
	L	3,777	3,777	3,777	3,777	3,777	3,777
1.K. Habitat Diversity Emphasis	H	N/A	N/A	38	38	38	N/A
	M	0	0	12,799	12,799	12,799	0
	L	0	0	383,741	383,741	383,741	0
1.M. Custodial area	VH		124,370				
	H		277,260				
2.A. Clifty Wilderness	VH	12,646	12,646	12,646	12,646	12,646	12,646
2.B. Beaver Creek Wilderness	VH	4,791	4,791	4,791	4,791	4,791	4,791
2.C. Wilderness Study Area	VH		2,834				
3.A. Developed Recreation	M	3,700	3,700	3,700	3,700	3,700	3,700
3.B. Large Reservoirs	H	30,673	30,673	30,673	30,673	30,673	30,673
3.C.1. & 3. Red River National W&S River Segment	VH	2,123	2,123	2,123	2,123	2,123	2,123
3.C.2. Proposed W&S River: Marsh Creek-Wild River	VH	1,244	1,244	1,244	1,244	1,244	1,244
3.C.4. Proposed W&S River: Cumberland River, War Fork Creek, Rockcastle River- Scenic Rivers	H	5,622	5,622	5,622	5,622	5,622	5,622
3.C.5. Proposed W&S River: Rock Creek and Marsh Creek Recreational Rivers	H	6,184	6,184	6,184	6,184	6,184	6,184
3.E. Red River Gorge	VH	16,042	16,042	16,042	16,042	16,042	16,042
3.F. Natural Arch Scenic Area	VH	1,065	1,065	1,065	1,065	1,065	1,065
3.H.1. Ruffed Grouse Emphasis	M	31	N/A	N/A	31	31	N/A
	L	10,504	0	0	10,504	10,504	0
4.A. Timber Production Emphasis	H						37
	M						10,708
	L						390,885
4.B. General Forest Area (1985 Plan)	H	6,798					
	M	20,328					
	L	499,379					
5.A. Communications Sites	M	20	20	20	20	20	20
5.C. Source Water Protection	M	6,343	6,343	6,343	6,343	6,343	6,343
	L	13,130	13,130	13,130	13,130	13,130	13,130
Total acres SIO	VH	22,876	151,472	22,876	22,876	22,876	22,876
	H	110,511	519,722	236,740	236,740	236,740	236,487
	M	26,499	4,771	24,752	24,752	24,752	17,823
	L	519,855	3,777	395,375	395,375	395,375	402,556

[1]Acres in Prescription Areas do not include water or unclassified acres. Some Prescription Areas overlap or lie within each other.

[2]SIO codes: VH = Very High; H = High; M= Moderate; L = Low; VL = Very Low.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Alternative A, which represents the 1985 Plan, would harvest 3,000 acres to a 15-square-foot basal area. Thirty-five miles of road would be constructed annually with 15,000 acres prescribed for burning each year. The existing variety of stand ages, mixture of species in stands of trees, forest openings, and vistas would remain the same. Acres with a Scenic Integrity Level of Very High or High where activity would occur total 107,101. Management activities would have a low likelihood of adversely affecting an area with a Scenic Integrity Level of High.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Annually, 443 acres would be scheduled for harvest to a 15-square-foot basal area; 350 acres would be harvested to a 40-square-foot basal area. Nine miles of road would be constructed annually and 2,377 acres would be burned. The existing variety of stand ages, mixture of species in stands of trees, forest openings, and vistas would reduce over time. Acres with a Scenic Integrity Level of Very High or High where activity would occur total 644,908. Management activities would have a very high likelihood of adversely affecting an area with a Scenic Integrity Level of High or Very High.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

Annually, 1,698 acres would be scheduled for harvest to 15-square-foot basal area; 1,483 would be harvested annually to 40-square-foot basal area. Fifty-six miles of road construction and 32,900 acres of prescribed burning would be planned annually. The existing variety of stand ages, mixture of species in stands of trees, forest openings, and vistas would remain about the same over time. The variety of stand types (woodland, wooded grasslands) would increase over time. Acres with a Scenic Integrity Level of Very High or High where activity would occur total 233,330. Management activities would have a very low likelihood of adversely affecting an area with a Scenic Integrity Level of High.

ALTERNATIVE C-1 & D

DIRECT AND INDIRECT EFFECTS

Annually, 1,705 acres of harvest 15-square-foot basal area would be planned along with 1,483 acres harvested to a 40-square-foot basal area. Fifty-six miles of road construction and 15,000 acres prescribed burning would be scheduled annually. The existing variety of stand ages, mixture of species in stands of trees, forest openings and vistas would remain about the same over time. The variety of stand types (woodland, wooded grasslands) would increase over time.

The acres with a Scenic Integrity Level of Very High or High where management activity would occur is 233,330. Management activities would have a very low likelihood of adversely affecting an area with a Scenic Integrity Level of High.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Annually 2,948 acres would be harvested to a 15-square-foot basal area; 361 acres would be harvested to a 40-square-foot basal area. Sixty-seven miles of road construction and 2,377 acres of prescribed burning would be planned annually. The existing variety of stand ages, mixture of species in stands of trees, forest openings, and vistas would remain about the same over time. The variety of stand types (woodland, wooded grasslands) would increase slightly over time. The acres with a Scenic Integrity Level of Very High or High where activity would occur is 233,330. Management activities would have a very low likelihood of adversely affecting an area with a Scenic Integrity Level of High.

SPECIAL AREAS

A “Special Area” has specific management direction based upon the Forest Service Manual, Secretary of Agriculture authority or Congressional authority. The Kentucky State Nature Preserves Commission and The Nature Conservancy made recommendations for special areas for the protection of biological diversity on the DBNF. Several prescription areas address these recommendations: Cliffline Community, Riparian Corridor, Rare Community, Research Natural Area, Old-growth, Signficant Bat Caves, Red River Gorge, both Wilderness areas, Natural Arch Scenic Area, and Wild & Scenic Rivers. The Habitat Diversity Prescription Area also addresses the recommendations. Some of these prescription areas are classified as Special Areas; others are not.

The following section discusses the Roadless Area analysis, which could lead to further Special Area classification.

ROADLESS AREAS

A roadless area re-inventory was completed for the DBNF as part of the analysis of the management situation. Several areas were examined in detail and found not to meet the criteria. The Wolfpen area did meet the criteria for a roadless area and became an inventoried roadless Area (Appendix C).

The Wolfpen inventoried roadless Area, within the Red River Gorge Geological Area and adjacent to the Clifty Wilderness, was examined for consideration as a Wilderness study area, as was the Jellico Mountain area and the Beavercreek Wildlife Management Area. Evaluation of these areas was based on the Forest Service Handbook as well as the Forest Service’s “Criteria for Roadless Areas in the East,” “Criteria for the Identification of Roadless Areas,” “Information needed for Forest Plan Revision,” “Southern Appalachian Assessment,” and the Regional Forester’s letter, “Clarification on Roadless Area Guidelines.” See Appendix C for more information.

The Wolfpen area, approximately 2,834 acres, is within the Red River Gorge Geological Area and is bounded on the east by Clifty Wilderness and the south by the Red River Wild and Scenic River corridor. It was evaluated by the Forest Service and found to meet the criteria as a Roadless Area in the East as defined in Forest Service Handbook 1909.12. The re-evaluation of the DBNF for potential roadless areas, confirms that the Wolfpen area is an inventoried roadless area and the only area that qualifies. The area has one small tract of rugged private land in the southwest corner that can be accessed without going through National Forest System lands. It contains two unimproved roads, and a portion of the Sheltowee Trace National Recreation Trail. Past human activities such as logging are fast disappearing. The Area like most of the Red River Gorge has very heavy recreation use and is heavily impacted by that use. Most human activity is related to dispersed recreation, primarily backcountry hiking and primitive camping. There are some privately held mineral rights within the area.

Roadless Area Conservation Rule

On January 12, 2001, the Forest Service issued the Final Rule for Roadless Area Conservation in the Federal Register. Since that time, numerous legal challenges have been made to this decision, including a ruling on July 14, 2003, from the United States District Court, Wyoming District, where Judge Clarence Brimmer found the Roadless Area Conservation Rule to be in violation of the National Environmental Policy Act and the Wilderness Act and enjoined its implementation. However, this issue is not settled. Appeals of the Wyoming District Court decision, other litigation, new rulemaking, or new FSM directives could result in a change in direction for inventoried roadless areas.

The Roadless Area Conservation Rule (Roadless Rule) would place restrictions on the road construction and reconstruction activities; and the timber cutting, sale, or removal activities that could occur in inventoried roadless areas. 36 CFR 294.12 and 294.13 identify the exceptions where road construction/reconstruction activities and timber cutting/removal activities would be allowed.

In this EIS, the inventoried roadless areas were evaluated for possible wilderness study area recommendations. If areas were not recommended for wilderness study designation, other land allocations were considered for these areas, depending upon the overall emphasis of each plan alternative. In some alternatives, a particular roadless area's characteristics would be maintained, while in other alternatives, the area's roadless characteristics could be altered. The following describes by alternative, what would happen to these land allocations should the Roadless Area Conservation Rule restrictions go into effect.

ALTERNATIVE A, C, C-1, D AND E-1

In Alternative A, C, C-1, D, and E-1 the Wolfpen Inventoried Roadless area (2,834 acres) is within the Red River Gorge Prescription Area. In this prescription area it remains an inventoried roadless area and will be evaluated as such during any site-specific analysis that includes the area.

ALTERNATIVE B-1

In Alternative B-1 the Wolfpen Inventoried Roadless area (2,834 acres) would be recommended for designation as a Wilderness study area. Wolfpen, which is immediately adjacent to Clifty Wilderness, could meet the criteria for Eastern Wilderness if existing recreation activities and roads are eliminated. The Wolfpen Inventoried Roadless area was not included in the Wilderness designation of the Clifty Wilderness because of the existing unimproved roads and the heavy recreation use I the area. No additional special areas are recommended for the 2004 Forest Plan.

LAND ADJUSTMENTS AND USES

Affected Environment

The Daniel Boone National Forest land adjustment program includes: administration of land purchases, exchanges, transfers, or donations; acquisition and granting of easements; location and maintenance of landlines; and resolution of title claims and occupancy trespass cases. Land adjustments may result in changes to National Forest System land boundary lines.

The area for this analysis includes National Forest System lands as well as all other lands within the DBNF proclamation boundary, totaling 2,042,474 acres. Analyses of direct, indirect, and cumulative effects of the various alternatives are also based on this area. Within the proclamation boundary, 34 percent -- 693,728 acres -- is National Forest System lands. Occasional small tracts of National Forest System land occur outside the Proclamation Boundary. Boundary lines totaling 4,085 miles encompass National Forest System lands. These figures reflect a mixed ownership pattern of public and private lands throughout much of the DBNF. This intermingled ownership sometimes results in boundary problems, title claims, encroachments, and access challenges. An estimated 600 to 700 of these types of cases exist on the DBNF.

Land adjustments are made through land purchases, exchanges, transfers, title claims, and Small Tract Act cases. The Small Tract Act of 1983 authorizes the resolution of claims involving less than 10 acres through sale of land, exchange of land, or a combination of both. Since 1990 the DBNF has purchased approximately 34,825 acres, gained more than 4,381 acres through exchange, and acquired 124 easements across private lands. Each year the Forest resolves about five to seven occupancy trespass cases and averages about three title claim cases.

Land uses are activities conducted on National Forest System lands by individuals (e.g., private property access), corporations (e.g. transmission lines), or political jurisdictions (e.g., potable water lines). Land uses are authorized either by a special use authorization, an easement deed, a cooperative agreement, or a memorandum of understanding. Of the number of special use authorizations on the DBNF, 19 percent are transmission uses, 45 percent involve public roads and utilities, and 11 percent involve recreation uses (Table 3 - 94). Special use authorizations impact about three percent of the total acres on the Daniel Boone National Forest.

Table 3 - 94. Types of land use on the DBNF, 2002, by number of authorizations and acres.

Kind of Use	# of Auths.	Acres
Transmission	81	2,302
Agricultural	39	182
Industrial	3	114
Public information & community	18	15
Recreation	47	17,758*
Research, study, training	12	568
Transportation	139	949
Utility/Communication	56	298
Water	34	207
Temporary Uses	70	N/A
Total	499	22,394

*Select Outfitter/Guide permits were for use of large areas.

Indicators used to evaluate land adjustments include acres of land added to or removed from the National Forest System. Numbers of special use authorizations were used to evaluate the impacts of each alternative from special uses. Because the exact number of acres or special use authorizations cannot be projected, a comparative method was used to illustrate the anticipated change in National Forest System lands acreage and uses as compared to the 1985 Plan.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

There are no environmental effects from the process of purchasing, exchanging, transferring, or donating land. Consolidation would have a similar result in all alternatives. Acquisition of private inholdings would promote more efficient administration. Similarly, disposing of scattered, isolated, and difficult to administer National Forest tracts would improve efficiency. As the National Forest becomes more consolidated, the need for easements would be reduced. Consolidation priorities, however, would differ based on the difference in Desired Future Conditions (DFCs) by alternative. The goals and DFC's of an area would guide what types of lands could be acquired or exchanged. A Landownership Adjustment Map, that displays current ownership, and priority areas for acquisition or exchange, in order to consolidate large areas is available at the Forest Supervisor's Office and at each District Ranger's Office.

Funding is one effect of land adjustments that would equally impact all alternatives. In the previous 10 years, funding for land acquisition has ranged from none to $2 million. Funding for a purchase program is related to the overall economy and influenced by public support.

Efficient maintenance of property lines would be a priority in all alternatives. Boundary maintenance is often included in project budgets. A decline in project funding would translate into less opportunity to use project dollars for boundary location. Any environmental consequence from boundary management for any alternative selected is expected to be negligible.

Trespass and title claim cases would be similar in all alternatives. As urban interface increases, the number of trespass and claims cases would also be expected to increase. Resolution of trespass and title claim cases in any of the alternatives would have negligible environmental consequences.

Granting easements and procuring rights-of-way to access National Forest System land would vary among the alternatives only in the size of the program. Providing the public with legal access to National Forest System lands would remain a priority in each alternative. Better access through rights-of-way acquisitions will make the Forest more accessible and result in better utilization of resources.

The Goals and Desired Future Conditions of an area would guide the types of uses authorized. Recreation residence permits on new sites would not be authorized in the future in all alternatives.

CUMULATIVE EFFECTS

Land adjustments and uses in any given year have never involved more than 5,000 acres (0.24% of affected environment). In the last 12 years combined, land adjustments and uses have involved 48,740 acres (2.4% of affected environment). There are no known, identifiable cumulative effects from land adjustments and uses.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Under this alternative, the 1985 Plan would continue to be implemented with no known effects to land adjustments and uses.

CUMULATIVE EFFECTS

None beyond those already described above.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Emphasis in this alternative is custodial management with a minimum of direct human influence. Maintenance of existing recreation facilities would continue. The land adjustment program would be expected to emphasize acquisition of wilderness inholdings, land in wild and scenic river corridors and land for ecosystem protection. Selection of this alternative would result in a reduction of land use authorizations since emphasis would be placed on minimizing direct human impact.

CUMULATIVE EFFECTS

None beyond those already described above.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative emphasizes ecosystem management while providing for multiple public benefits. The land adjustment program would focus on obtaining diverse or underrepresented habitat types, environmentally sensitive lands such as wetland, old-growth, and riparian sites and land needed for protection of PETS species habitat. Selection of this alternative would result in very little change in special use management.

CUMULATIVE EFFECTS

None beyond those already described above.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize maintenance of ecological process and function while providing for multiple public benefits with an emphasis on recreation. Land adjustment emphasis would be similar to Alternative C except for a heavier interest in acquiring land suitable for recreation use. Special use activity would differ only slightly from existing activity. An increase in recreation related authorizations, such as outfitter/guides, concessionaires, and recreation events, could result from selection of this alternative.

CUMULATIVE EFFECTS

None beyond those already described above.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize recreational opportunities to the extent possible. The emphasis for land adjustment in this alternative would be acquisition of lands that enhance recreational opportunities. Some examples would be wilderness inholdings, water frontage property, lands with aesthetic or heritage resources, or lands offering more dispersed recreational opportunities such as hunting, fishing, hiking, and primitive camping. Selection of this alternative would likely increase the number of special use authorizations. A heavy emphasis on recreation would generate more requests for outfitter/guides, recreation event and concessionaire authorizations.

CUMULATIVE EFFECTS

None beyond those already described above.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

In this alternative the emphasis would be on production of goods and services beneficial to local and regional communities. This alternative would have effects similar to Alternative A. Land adjustment would have the widest latitude for development. Land suitable to provide high-quality forest products, wildlife, non-timber forest products, recreation, minerals, and for special uses would be targeted for acquisition. Special use authorizations would likely increase in an effort to provide maximum quality utilization from the forest.

CUMULATIVE EFFECTS

There would be no cumulative effects beyond those already described above.

Socioeconomic Environment

Affected Environment

The Daniel Boone National Forest includes parts of 21 eastern Kentucky counties. These 21 counties constitute the Forest's Area of Influence (FAI).

The DBNF is adjacent to the southern Appalachian assessment Area (SAA), which extends southward from the Potomac River to northern Georgia and the northeastern corner of Alabama. This region includes parts of seven states, 135 counties, and covers approximately 37 million acres. The Daniel Boone National Forest Area of Influence is in close proximity to the SAA and the economic and social environment for the FAI are very similar to that of the SAA.

The USDA Forest Service, along with many other federal agencies, completed a broad assessment of this region in 1996 known as the Southern Appalachian Assessment (SAA). One component of this analysis, the "Social, Cultural, and Economic Technical Report," assesses social and economic conditions of the southern Appalachian area. The following assessment of the Daniel Boone National Forest attempts to compare the Forest's socioeconomic environment with similar findings from the Southern Appalachian Assessment. A comparison with the socioeconomic environment of Kentucky is also made. Data for the Forest's area of influence more nearly resemble those of the SAA than those of Kentucky at large. The following topics will be presented in the Forest's assessment:

- Demographic Changes and Trends in the Economy
- Effect of Demographic Changes on Natural Resource Management
- Impact of Natural Resource Management on the Economic and Social Status of Local Communities
- Influence of Publics Outside Southern Appalachia and their effect on Management of Ecosystems and Public Land
- Values and Attitudes of Southern Appalachia Residents toward Natural Resources and Ecosystem Management
- Priorities for Management of Private Land by Non-industrial Owners.

Social attitudes, values, and beliefs are elements used to describe and understand the human dimension of resource management. This information is used to predict possible effects on local communities. These effects may include acceptance of or resistance to the decisions made. Social analysis coupled with economic demographic information forms the human dimension of ecosystem management. This information is used with the biological and physical analysis to best understand potential effects on the land as well as the human environment.

DEMOGRAPHIC CHANGES AND TRENDS IN THE ECONOMY

DEMOGRAPHIC CHANGES

One measure of how dynamic and subject to change an area may be is the growth of population and its various racial and ethnic components. A static area will imply few potential issues affecting change. Conversely, a dynamic and growing population may produce many conflicting issues for land managers to consider. Certain areas of National Forest System and surrounding lands, which are attractive to urban dwellers for recreation as well as for second or retirement homes, may produce issues which conflict with traditional residents of the area.

Demographic changes for the Southern Appalachian (SA) Assessment area are given first in the analysis followed by that of the Forest's area of influence (FAI); then a contrast is given between the SAA region, the FAI, and Kentucky. Many time frames used in the SA Assessment were not available for the DBNF, and data more recent than 1990 were not available in the Assessment. Therefore, direct comparisons between the two are not possible at times.

Population increased by 7.3 percent from 1980 to 1990 in the southern Appalachian region. This compared with a decline 0.6 percent for the FAI, and an increase of 0.7 percent for Kentucky. During the 1990-2000 decade the Forest counties went from a net loss in population to a growth just one-percentage point less than the state of Kentucky for the period. Tables E - 1 through E - 7 of Appendix E show population characteristics and their rates of change for each county within the Forest proclamation boundary, while the table below illustrates significant population changes from 1980 to 1990 and 1990 to 2000 for all counties within the DBNF analysis area:

Table 3 - 95. Minority and percent population change in the DBNF analysis area, 1980-2000*.

Area	Percent Population Change 1980-1990	Percent Population Change 1990-2000	Percent Minority Population 1990	Percent Minority Population 2000
DBNF Counties	-0.6	8.59	1.52	2.69
Kentucky	0.7	9.70	7.96	9.92
SAA Findings	7.3	NA	8.1	NA

*Data obtained from U.S. Census Bureau.

While minority population increased by a little over one-percentage point between 1990 and 2000 within the proclamation boundary, it remains at a very low level. The minority population within Kentucky increased by almost two percentage points during the same time. Meanwhile, the SAA had a minority population of 8.1 percent in 1990, about 6.5 percent more than that of the FAI.

Table 3 - 96. Population density within the DBNF analysis area, 1980-2000*.

Area	Population Density 1980 (people/square mile)	Population Density 1990 (people/square mile)	Population Density 2000 (people/square mile)
DBNF Counties	55.9	55.6	60.4
Kentucky	92.1	92.8	101.7
SAA Findings	94.0	102.0	NA

*Data obtained from U.S. Bureau of Census.

Population density, meanwhile, was 102 people per square mile in the SAA in 1990, while the population density for the FAI was 55.6 people per square mile, and 92.8 people per square mile in Kentucky. While population density changed from 94 persons per square mile during 1980 in the SAA, it changed from 56 persons per square mile in the FAI and 92 for the state. Population density increased only marginally in the state and Forest during the 1990 decade (Table 3 - 96).

The significance of these population changes is that the FAI population declined less than one percent during 1980-1990 while the state population increased by less than a percent, while the SAA increased over seven percent during the period. The FAI populations increased by a little over 8.5 percent while the state grew a full percentage point more, 9.5 percent, during the 1990-2000 decade. Thus, while the rate of growth has picked up in the Forest area, it still trails the growth rate of the state. Minority population also lags behind that of the SAA and Kentucky. This is to be expected because of the larger urban populations found in the latter two areas. The county population changes are in Table E - 7 of Appendix E.

The rural nature of the area is contrasted with the state and SAA below. For a breakout of all counties within the forest boundaries, see E - 11 of Appendix E.

Table 3 - 97. Percent of population living in rural areas of the DBNF analysis area, 1980-1990.*

Area	Percent Rural Population 1980	Percent Rural Population 1990
DBNF Counties	84.8	83.8
Kentucky	49.1	48.2
SAA Findings	NA	53.0

*Data obtained from U.S. Census Bureau.

The FAI has become less rural since 1980. The percentage of persons living in rural areas for the aggregated counties making up this area has decreased from 84.8 percent in 1980 to 83.8 percent in 1990. This is a one-percentage point decrease but remains over 30 percent more rural than the SAA was in 1990. However, Kentucky is less rural that either the SAA or the FAI in 1990. The state lost its rural area by about the same percent as the FAI from 1980-1990. With a net decrease in population within the Forest counties during the 1980s, there was still an expansion of the urban areas within the area.

Per capita income is a relative measure of the wealth of an area. It constitutes the personal income from all sources divided by the population of that area. For the SAA the per capita income average was $10,950 in 1990; for the FAI it averaged $6,912 and for Kentucky it was $9,546.

Table 3 - 98. Per Capita Incomes 1980 – 1990.

	1980 Per Capita Income	1990 Per Capita Income	Real Avg. Annual % Change ’80-’90 per Capita Inc.
Forest Counties	$3,919	$6,912	1.0%
Kentucky	$5,973	$9,546	0.1%
SAA	$6,377	$10,950	0.8%

Source: U.S. Bureau of Census

Income for the Forest area grew faster on a real basis (inflation adjusted) than the SAA and Kentucky's income during the 1980s. The DBNF area grew at a one percent rate; Kentucky grew at a 0.1 percent rate, while the SAA grew only by 0.8 percent (Tables E - 12, through E- 14 of Appendix E for a forest breakdown and other income measures). Thus, an individual's financial well being increased at a greater rate in the DBNF analysis area than that of the SAA and Kentucky for the 1980s decade. Even though the growth was greater, the Forest area is still well behind earnings in Kentucky and the SAA area.

Table E - 18 of Appendix E has income data for the Forest and state based on Bureau of Economic Analysis (BEA) measurements. This data is per capita personal income, which is not directly comparable with the Bureau of the Census per capita income data shown above and in Table E - 12 of Appendix E. The two data sets are not the same because census data is obtained directly from households, whereas the BEA income series is estimated largely on the basis of data from administrative records of business and governmental sources. Also the definitions on income are different. Caution also must be used in comparing growth rates of Table E - 18 with Table E - 12 because growth in Table E - 18 is based on real or inflation adjusted dollars while growth in Table E - 12 is based on nominal dollars (unadjusted for inflation). Thus from the table above, it is evident that the FAI is still relatively poorer than either the state or the SAA, but its per capita income did grow a little faster than the state's during the 1980s.

Table E - 8 in the appendix has information on the percent of children below poverty in 1989 with Owsley at 64 percent in contrast with Oldham County outside the FAI at only seven percent. Table E - 8 has other social characteristics of the counties in the FAI compared to the counties within Kentucky with the lowest or highest percent of the characteristics listed.

Another indicator of relative economic prosperity is the percent of the workforce unemployed. Unemployment rates change dramatically over time, depending in large part on the national economy. Unemployment problems persist in some areas because of low educational attainment, lack of skills, and in some cases physical isolation.

In 1990, the Forest had a higher unemployment rate (9.1%) than either the state (7.0%) or the SAA (6.5%).

Table 3 - 99. Unemployment Rates 1990 and 1997.

	1990 Unemployment	1997 Unemployment
Forest Counties	9.1%	7.4%
Kentucky	7.0%	5.4%
SAA	6.5%	NA

Source: U.S. Bureau of Census & U.S. Bureau of Labor Statistics.

During the 1990s the unemployment rate has decreased by more than a percentage point for the Forest analysis area and the rate has decreased by close to the same amount, 1.6 percent for Kentucky. However, the unemployment rate within the Daniel Boone analysis area is still two percentage points higher than that of the state. More resolution in unemployment rates for the Forest (by county) can be found in Table E - 19 of Appendix E.

The percentage of people in poverty is represented in Table 3 - 100. (More specific Forest information can be found in Table E - 13 and Table E - 14 of Appendix E.)

Table 3 - 100. Poverty Rates 1989 and 1995.

	1989 – Percent of People of all ages in Poverty	1995 – Percent of People of all ages in Poverty
Forest Counties	34.8%	32.1%
Kentucky	19.0%	17.9
SAA	11.0%	NA

U.S. Bureau of Census, Small Area Income and Poverty Estimates Program.

Many of the counties in the Daniel Boone analysis area had very high rates of poverty in 1989. The average was much higher for the Forest area than either Kentucky or the SAA. In 1995 it is estimated that the State of Kentucky had a little over one percent lower poverty rate, and the Forest had almost a four percent lower rate than that found in 1989. The SAA was based on data through 1990; therefore, more recent data are not shown for this area. The poverty rate for the Forest area remains almost double that of the State's.

The U.S. Department of Agriculture, Economic Research Service rates all of the 21 analysis area counties as in persistent poverty. They define a county in this category if persons with poverty-level income were 20 percent or more of total population in each of four years: 1960, 1970, 1980, and 1990. Table E - 13 of Appendix E further supports the depressed economic status of residents in these counties.

Table 3 - 101. Housing Units 1970-2000.

	Housing Units % Change 1970-1980	Housing Units % Change 1980-1990	Housing Units % Change 1990-2000
Forest Counties	38.2%	10.2%	15.9%
Kentucky	28.6%	10.1%	13.9%

Source: U.S. Bureau of Census.

Median housing value is contrasted in the table below with information by county in Table E - 15 in Appendix E. Housing values within the Daniel Boone analysis area tend to be substantially below that of Kentucky and the SAA where more urban areas are found. Housing values are determined principally by the extent of demand. The greater the demand, the higher prices are bid up. Population changes, the movement of people, and job changes play a factor in housing demand. Population has only begun to increase at a significant rate in the 1990s. Housing stock increased at a significant rate in the decade of the 1970s and 1980s. However, value is still low compared with the state, which has the influence of urban areas and economic growth that support higher priced housing. In regard to new home additions, however, the Daniel Boone analysis area is still fairly dynamic as shown in Table E - 15 in Appendix E. Population and wage growth will have to increase significantly to warrant significant increases in housing values.

Table 3 - 102. Housing Values 1980 and 1990.

	Housing Units Median Value 1980	Housing Units Median Value 1990
Forest Counties	$23,068	$32,582
Kentucky	$34,200	$50,500
SAA	NA	$59,700

Source: U.S. Bureau of Census.

Table E - 15 of Appendix E shows more specific data for the Daniel Boone analysis area for both housing units and median value of housing units.

TRENDS IN THE ECONOMY

Analyzing the major sectors of an economy allows insight into how diverse and what industries may be driving its growth. Table E - 18 of Appendix E shows the entire economy broken out by major Standard Industrial Code (SIC) and by important industry sub-sectors for wood products and for an estimate of the contribution of certain industries to tourism.

The table below shows the manufacturing sector, the sub-sectors for wood based industries, and an estimate of the tourism industry for percentage of industry output and employment for 1985 and 1996. Tourism is not a single economic sector. It is part of several service and retail industries. The percentage of each of these industries attributed to tourism was taken from the work of Gordon McClung at West Virginia University.

Table 3 - 103. Economic Diversity 1985 – 1996.

Sector	Industry Output % Total 1985	Industry Output % Total 1996	Employment % Total 1985	Employment % Total 1996
Manufacturing	24.2%	30.7%	16.3%	15.9%
Mfg. Lumber and Wood products	1.6%	3.8%	1.8%	2.6%
Wood Furniture and Fixtures	0.4%	0.7%	0.6%	0.5%
Paper and Pulp Products	0.1%	0.3%	0.1%	0.1%
Tourism	1.2%	1.2%	1.9%	2.2%
Total Economy	$8,581.50*	$12,609.9*	130,683	191,132

*In Millions of dollars. Source: 1985 and 1996 IMPLAN Data.

From the table above it is evident that the DBNF area economy is growing more reliant on manufacturing. Although output increased by over six percent from 1985 to 1996, jobs did not keep pace, employment in manufacturing decreased by 0.4 percent. Still, manufacturing accounted for less than a third of the economy in 1996.

Meanwhile, the SAA's economy in 1991 showed a 42 percent share of the economy for manufacturing; almost double that of Daniel Boone local economy in 1985. Even at these levels, the SAA and the Daniel Boone analysis area show a concentration in manufacturing that is much higher than that of the U.S. economy, which is less than 20 percent.

Of the manufacturing sector, wood products maintain a 4.8 percent share of the local economy's total output in 1996, which is more than over double the 2.1 percent share it had in 1985. Employment grew from a 2.5 percent share in 1985 to a 3.2 percent share in 1996. Employment in the wood products industries resulted in a 3.4 percent share of the SAA economy in 1991. Industrial production had a 5.2 percent share. The wood products industries have about the same importance in the Daniel Boone's economy as that of the SAA.

Tourism is defined as any non-business related travel of 100 miles or more from home. Recreation would be a subset of the tourism estimate; therefore its share of the economy would be something less than the tourism numbers.

The estimate of tourism's share of the economy was about the same for output between 1985 and 1996. Employment, on the other hand, increased slightly from a 1.9 percent to a 2.2 percent share of the local economy's total.

Table E - 18 of Appendix E compares the DBNF analysis area's economy for 1985 and 1996 for all nine major sectors of the economy.

Besides the manufacturing change mentioned above between these two years, other significant changes include construction's increase from 4.8 percent of output in 1985 to 6.9 percent in 1996; the mining sector's decrease from 17.7 percent to 7.9 percent in 1996; and the service sector's non-tourism related increase from 8.7 percent to 14.1 percent in 1996. Thus, the local economy is becoming more diverse, but it is still heavily reliant upon manufacturing for the majority of its activity compared to the national economy.

The comparison on an average annual rate of change does allow a degree of comparison. The following table compares the rate of change between the SAA's economy and that of the DBNF analysis area:

Table 3 - 104. Economy dynamics.

	Employment Avg. Annual Change	Industrial Output Avg. Annual Change
Forest Counties*	4.2%	4.3%
SAA**	1.9%	2.6%

* Change from 1985 to 1996. Source: 1985 and 1996 IMPLAN Data.

** Change from 1977 to 1991. Source: 1977 and 1991 IMPLAN Data.

Clearly, output has grown much faster for the Daniel Boone NF local economy (4.3 percent) than the SAA (2.6 percent per year). Meanwhile growth in employment has been about the same with only 0.1 percent difference in growth of Industrial Output and Employment.

A principle way an economy grows is by export of goods and services. Most typically, manufacturing activity is thought of as providing most of this export related activity. However, services and retail trade can be considered "export" industries if a large number of visitors come from outside in travel related activities to bring in new dollars. Tourism is classified as an export driven activity. A manufacturing industry can be a net importer if it imports more of a commodity that it exports.

Table E - 20 of Appendix E shows all the major sectors and industries contributing to the export activity within the DBNF analysis area.

The chart below compares the exporting characteristics of the DBNF's analysis area for 1985 and 1996.

Table 3 - 105. Exporting Industries 1985 and 1996.

Commodity	Net Exports (Exports Less Imports)		Net Exporting Industries as a Percentage of Total Positive Exporting industries	
	1985*	1996*	1985	1996
Agriculture	$223.2	$70.8	13.3%	6.8%
Mining	$1,055.6	$573.2	63.1%	54.7%
Mfg. Lumber & Wood Products	$55.0	$250.7	3.3%	23.9%
Mfg. Wood Furniture & Fixtures	$0.4	$18.6	0.0%	1.8%
Mfg. Paper & Pulp Products	-$70.3	-$90.7	0.0%	0.0%
Total Mfg.	-$672.0	-$466.9	0.0%	0.0%
Transportation & Utilities	$9.9	$135.5	0.6%	12.9%
Estimate of Tourist Trade	-$19.9	-$36.6	0.0%	0.0%
Government	$329.2	-$73.3	19.7%	0.0%
Total Net Trade (Exports)	-$1,005.6	-$2,780.3	100.0%	100.0%
Total Positive Export Industries	$1,673.3	$1,048.7		

* In Millions of dollars. Negative numbers are net importers and positive numbers are net exporters.

Source: 1985 and 1996 IMPLAN Data.

The local economy was a net importer of just over $1 billion in 1985. In 1996, imports totaled approximately $2.78 billion, more than twice the 1985 level. Large changes occurred in the wood products industries. Two sectors (Mfg. Lumber and Wood Products and Mfg. Wood Furniture and Fixtures) increased their exports significantly. The paper and pulp products industries increased their net imports, but at a much slower rate than the other two increased their exports. Total manufacturing continued to be a net importer but cut the import dollars by a third. Total export changes from 1985 to 1996 decreased from approximately $1.67 billion to $1.05 billion. The loss of exporting volume is important because the regional economy has had less opportunity from 1985 to 1996 to bring new money into the economy from outside its region for the purposes of internal growth. To the extent that a region imports more than it exports, money "leaks" outside the economy reducing the ability of the multiplier effect of new purchases by its residents.

"Total positive export industries" dollars provide the basis for expressing the percentage of an industry, which is a net exporter, to determine its share of total exports. Thus, manufactured lumber and wood products in 1985 had exports totaling $55.0 million, which was 3.3 percent of $1,673.3 million for all net exporting industries in the area.

All of the net exporters for the DBNF analysis area are shown in the above table. Government is the only industry that changed from a net exporter to a net importer between 1985 and 1996. Government went from exporting $329.2 million in 1985 to importing $73.3 million in 1996. Agriculture decreased its export from $223.2 million to $70.8 million, while mining cut its exports in half from $1,055.6 million to $573.2 million. Three sectors (Transportation and Utilities, Lumber and Wood Products and Wood Furniture and Fixtures) significantly increased their net imports. The Transportation and Utilities sector increased exports from $9.9 million to $135.5 million. Although this is a significant increase in exports it is only a 12 percent increase in the percentage of total positive exporting industries. Tourism almost doubled its imports from -$19.9 million to -$36.6 million. Thus, there are still more travelers from within the area than from outside the analysis area;

or those traveling from outside the area are not spending as much money in the local economy as the local travelers.

The SAA area was a net exporter in 1991 of goods and services of $15.8 billion. Manufacturing was the largest net exporting sector, representing $24.6 billion. Manufacturing represented 156 percent of the net exporting sectors. Construction ($6.7 billion) and services ($4.3 billion) were the largest net importers and contributed to a drain of money from the economy.

Thus, the Daniel Boone analysis area economy doubled its net imports from -$1,005.6 million in 1985 to -$2,780.3 million in 1996, further draining the resources of the area. The increase in imports adds to the overall decline of the areas economy. Although more industries have become a part of the economy, they have not improved the balance of trade.

The overall earnings of counties in the analysis area are low. Total earnings for Fayette County, which is within 50 miles of the analysis area, was $4,981,847,000 in 1997. The total earnings of all of the analysis area counties combined were $3,378,665,000 for 1997. Table E - 19 of Appendix E lists the earnings of each county by economic sector. The USDA Economic Research Service identifies the resource dependency of each rural county in the country. The Dependency of the Forest counties is shown in Table E - 21 of Appendix E. Manufacturing contributed a weighted annual average of 30 percent or more of total labor and proprietor income over the past three years in one county (Wayne). Service activities (private and personal services, agricultural services, wholesale and retail trade, finance and insurance, transportation and public utilities) contributed a weighted annual average of 50 percent or more of total labor and proprietor income over the past three years in three counties (Lee, Pulaski, Whitley). Mining contributed a weighted annual average of 15 percent or more of total labor and proprietor income over the past three years in four counties (Clay, Harlan, Leslie, Perry). Government contributed a weighted annual average of 25 percent or more of total labor and proprietor income over the past three years in five counties (McCreary, Menifee, Owsley, Rowan, Wolfe). And eight counties were not classified as a specialized economic type over the past three years (Bath, Estill, Jackson, Knox, Laurel, Morgan, Powell, Rockcastle). Income from transfer payments (federal, state, and local) contributed a weighted annual average of 25 percent or more of total personal income over the past three years in all but six of the 21 analysis area counties.

No one economic sector dominates the Analysis Area. The Shannon Weaver county-level diversity index ranges from 0.45 for Leslie County to 0.66 for Pulaski County. Twelve counties are in the 0.50 to 0.59 ranges and eight of the counties are in the 0.60 to the 0.66 ranges. Fayette County with the urban area of Lexington has an index of 0.65 (see Appendix B Diversity Analysis).

Although no one sector dominates the economy, the 21 county areas have only 232 industries out of the 528 that are tracked. This compares to 214 for Fayette County alone and 446 out of 528 for Kentucky. Fayette County's 214 industries employ 192,086 people and have a total income of $8,261,950,000. The 21 counties Analysis Area employs 179,117 people and has a total income of $6,100,225,000.

Payments in Lieu of Taxes (PILT) are funds that the federal government transfers to counties to help offset the non-tax status of federal lands within their boundaries. PILT is a payment from the Bureau of Land Management that covers shortfalls from natural resource consumption on the national forest. That is, if the Forest Service's Twenty Five Percent Funds (25 % Funds) from timber harvesting, mining and recreation do not cover at least $1.75 per acre, PILT will make up the shortfall.

Trends in 25 Percent Funds and PILT are important to show a possible erosion of an area's tax base. Table E - 22 and Table E - 23 of Appendix E break out revenues for each of the 21 Forest counties. The chart below shows Forest counties in the aggregate changes from various years for data that was common between the two sources.

Table 3 - 106. PILT Funds for Forest Counties 1990 and 1999.

	1990	1999	% Change 1990-1999
PILT	$343,684	$476,518	38.7%
25% Funds	$458,599	$68,621	-85.0%
Total	$804,273.00	$547,138.00	-32.0%

Source: U.S. Bureau of Land Management.

County revenues from the federal government have been variable since 1936, the first year of available data for 25 Percent funds. The 25 Percent funds have declined dramatically since 1997 from $294,031 in 1996 to $68,621 in 1999, due to reduced timber harvesting. At the same time PILT funds have trended up as a replacement of lost revenues from timber harvesting. Taking the two payments together, there was a 32.0 percent decrease for the DBNF analysis area from 1990 to 1999.

Land use and its change over time is an indicator of the dynamism of an area. Areas converting from rural uses to urban uses have implications of change that affect residents. The chart below shows the land use of weighted average acres of the counties, which comprise the DBNF analysis area for 1982-1992, for all uses except urban. Urban comprises a small share and can be found along with characteristics of all counties in the analysis area in Table E - 24 of Appendix E.

Table 3 - 107. Land Uses 1982 and 1992.

	Forest '82 % Share	Forest '92 % Share	Farm '82 % Share	Farm '92 % Share	Residual '82 % Share	Residual '92 % Share
Weighted Average Acres for Forest Counties	20.4%	21.9%	57.3%	53.2%	20.5%	22.0%

Source: Natural Resource Information System.

This data set from the Natural Resource Conservation Service includes federal land within their residual category. Residual also includes highways and power line access rights of ways. The Forest category contains lands of private timber owners.

Over three-fourths of this private area was either in farm or forest cover in 1982 (77.7%). By 1992 this percentage had decreased over two percent to 75.1. Twenty percent (20.4%) was forested in 1982, and 21.9 percent was forested in 1992. This is over a one percent increase in forested land over the period. So as farmland decrease, both forest land and urban areas increased. The urban share of the land increased from 1.8 percent in 1982 to 2.9 percent in 1992 (Table E - 24 of Appendix E). This land use has increased its acreage by one percent in the last 10 years.

The SAA found that little forest land was lost between 1970 and 1990 in that region. However, urban, road, and housing development growth caused by increased population in the area took farmland, pastures, and open space. Retirees and commuters from nearby urban centers were responsible for part of that demand for development.

The DBNF, meanwhile, experienced small declines in the rural character of the landscape from 1982 to 1992 (about a 2.6 percent decline in share over this period). Urban areas gained about 1.1 percent of the total share of land use during this time.

SUMMARY OF DEMOGRAPHIC AND ECONOMY CHANGES

Population and economic dynamics are changing at a moderate rate within the DBNF analysis area. While population declined slightly from 1980 to 1990 (-0.6%), growth began to increase during the 1990 to 2000 period (8.59%). This is still a third as fast as it grew from 1970 to 1980 (24.5%). It is one percent less growth from 1990 to 2000 for the analysis area than for Kentucky. Increased population suggests the area may have new residents from outside the area, which will present non-traditional ideas from those of long-standing residents, possibly those that are non-commodity based.

Minority population has changed slightly within the analysis area from 1990 to 2000. Minority share increased about one percent from 2.16 percent to 2.69 percent over this time, indicating some growth. While these numbers are still less than the share found across Kentucky in 2000 (9.92 percent) and the nation (approximately 13 percent), there is indication that minority population is not leaving the area, and there are increased opportunities for minority participation in local recreation endeavors.

The analysis area became slightly less rural from 1980 to 1990. The rural character is still in place in Daniel Boone analysis area with over three-quarters of the land in a rural character. Urban encroachment does not yet appear to be a problem.

The area’s economic health as measured by per capita income grew 0.1 percent per year during the 1980s, greater than that for all of Kentucky. Still, per capita income in 1990 was about $2,600 less than that of the state’s. The area’s unemployment rate decreased by over one percent from 1990 to 1997; however, it was still two percent greater than Kentucky’s, which was at 5.4 percent in 1997. Income growth in this area has progressed steadily, indicating that the area is improving economically. People with strong incomes and jobs are more likely to have free time and need an outlet for recreation. The DBNF is a prime outlet for these people.

The area’s poverty rate declined by three percent from 1989 to 1995, a rate faster than Kentucky’s. Percentage of female head of households was low and holding steady; persons per household were lower than the state’s average. The area is showing signs of economic improvement but there are still segments of the economy that are not growing as fast as the rest of the state. The income level for the area remains low compared to the state, and the poverty level is much greater that that of the state’s.

Housing unit growth was about the same as the state for the decade of the 1980s. Median housing value, however, is still over $17,000 less than the state average of $50,500, a condition that can be expected with a larger urban component.

The DBNF analysis area’s economy has become less diverse and more concentrated in the manufacturing sector. As measured by total output, manufacturing is about 31 percent of the economy, becoming a dominant share. The services sector has almost doubled its share while retail activity has remained constant. Wood products manufacturing in 1996 held about a 4.8 percent share of the total regional economy, an increase of 2.7 percent share from 1985. Tourism, meanwhile, maintained a 1.2 percent share in both measurement periods.

Since 1985, the area has doubled its net exports. Wood products have significantly increased its net exports from $55 million to $250.7 million, indicating that money is coming into the economy from these industries. Economies that export more than they import are able to grow faster than those that are net importers.

Land use has changed very little since 1982. The analysis area has gained over one percent of its forest cover on private lands. Forest cover on public lands has remained constant with a slight increase due to acquired lands reverting from pasture and openings to forest cover.

Thus, the economy and demography of this area appears to be typical for a rural area. Population began to increase in the 1990s, poverty declined slightly, and housing construction grew. The economy continues to restructure itself a little but relies more on the economically sensitive manufacturing sector. Finally, the economy remains a major importer.

EFFECT OF DEMOGRAPHIC CHANGES ON NATURAL RESOURCES

Little forest land has been lost since 1970 in the Southern Appalachian region, urban, road and housing development growth, caused by increased population, has taken farmland, pastures, and open space. Retirees and commuters from nearby urban centers are responsible for part of this demand for development.

In the Daniel Boone area there was an overall increase in forest land, with nine of the 21 counties showing a decrease in forest. Population in the area also decreased from 1980 to 1990 with only seven counties increasing in population. This trend turned around during the 1990s with all but four counties increasing in population.

Newcomers to the region feel differently than long-time residents about natural resources. Often, the latter's livelihood is dependent upon manufacturing from natural resources. Managers of natural resources have had to respond to new sets of values and preferences, particularly increased demand for land, water resources, scenery, recreation, and tourism.

Population in the region is projected to grow by 12.3 percent by 2010, slightly less than the growth rate expected for the nation (13.1 percent). Most of the growth is expected to be in northern Georgia, western North Carolina, and portions of eastern Tennessee and northwestern Virginia.

The increase in population density across all counties in the region has impacted farms, forests, and pastures and has removed habitat for most species of wildlife and fish. More people entering the area has resulted in greater amounts of land conversion and impacts to water quantities, quality, and use. At higher elevations, development has impacted visual qualities.

As certain areas of the region have been developed, more urban pressures have impacted the land. Private lands have become posted as "off limits", causing public lands to become more crowded. This greater private land restriction has put more pressures on public land to accommodate increased demand for tourism and recreation.

The movement of people into the DBNF's region has been primarily along the fringe of the area. Even with parkways bisecting the Forest, public services such as hospitals, retail centers, public water, sewage treatment, and garbage disposal are just becoming common within the core of the area. New arrivals to the area expect basic services experienced elsewhere. They also arrive from a suburban or urban culture where needs are derived from institutions rather than from the land, extended family, and community.

Long time residents of the area have watched major changes in farming, plants, animals, and forest land as it has occurred. They expect changes to some degree and anticipate the changes that commonly occur in rural farm and forest land. New arrivals expect change in suburban or urban settings but have little experience with rural changes.

Interaction with local residents is needed now more than ever. Early involvement of the public is essential to the understanding of the forest management activities that occur on the DBNF.

National Forest planners needed to understand the people who live in the southern Appalachian region, how they relate to the National Forests in the area, and what they want or expect from the National Forests through natural resource management. During the planning process, numerous public meetings were held to allow attending interested people an opportunity to express their wants, needs, and demands for access to and use of DBNF resources. These public meetings, however, typically represent only a portion of the public's interests and seldom represent the so-called "silent majority" who do not or cannot attend these meetings. Region 8 commissioned the Southern Research Station to undertake a telephone survey to randomly survey the public. Such a survey provides input from this broader public concerning what they would like to see emphasized in National Forest management.

Region 8 and the Southern Research Station compiled a number of survey questions to learn how people perceive natural resource management. Answers to these survey questions, it is believed, can help National Forest planners with knowledge of the public's:

- Values, attitudes, and beliefs at a forest level
- Activities on National Forest System lands
- Feelings toward natural resource management in general
- Expectations of how National Forests should be managed
- Opinions on environmental issues in the southern Appalachian area.

The random survey for the Daniel Boone included residents within 75 miles of the Forest. The random survey included more than 60 percent of the Daniel Boone market respondents living in Tennessee, with just under 20 percent of the sample living in Kentucky. This area includes Lexington and Covington, Kentucky; Cincinnati, Ohio; and Knoxville, Tennessee.

The following summary of information was excerpted from the "Public Survey Report, Southern Appalachian National Forests, and Daniel Boone National Forest" (Note: the SA region for this survey included the DBNF and areas within 75 miles of five other National Forests. It is not the same as the SAA.)

Some noticeable differences exist in the personal and household characteristics of the DBNF market area compared to those of the full SA region. Year-round residents comprise about 97 percent of respondents in each, however, higher proportions of Daniel Boone area residents have lived in the SA region their entire lives (44% vs. 38%), lived there longer (62% vs. 52%), own rural land (18% vs. 13%), and remain in the SA region for either a job (9% vs. 7%) or the attractiveness of the area (19% vs. 15%). The percentage of shorter-term residents is larger in the full SA region, for both residents of 10 years or less (29% SA vs. 22% DBNF) and residents of 10-19 years (19% vs. 16%). More SA region respondents came to or remain in the SA region for family reasons than did DBNF market residents (55% vs. 50%)."

Almost 94 percent of DBNF market area residents are non-Hispanic white compared to 75 percent in the SA region. Just three percent of the Daniel Boone market area is black in contrast to nearly 20 percent in the SA region. The proportion of Hispanic residents is also larger in the SA region, although both comprise less than five percent of the market. Foreign-born persons are also less common in the Daniel Boone market area. The Daniel Boone market has a larger proportion of people over age 55 and lesser-educated individuals. It has a lower proportion of people under age 30 and persons with advanced degrees. In addition, fewer people work at a job and relatively more are retired in the Daniel Boone area compared to the entire SA region.

Among the 20 activities included in the survey of SA residents, the most popular in the Daniel Boone market area are driving for pleasure (over 3 in 4 participate), picnicking (63%), viewing and photographing wildlife, fish, or scenery (just over 3 in 5 participate), day hiking (41%), and visiting a wilderness or other primitive area (about 2 in 5 participate).

In the Daniel Boone market area swimming (38% participating), fishing (37%), and motor boating/ water skiing (27%) are popular water-based recreation activities. Gathering natural forest products (32%), camping at developed sites (28%), and off-road driving (27%) are other popular land-based activities. Every activity, with the exception of backpacking, mountain biking, and canoeing/kayaking, exceed the participation rates of both the full SA region and the nation.

Residents value the Daniel Boone National Forest in many different ways. At the top, they are viewed as important for passing along natural forests for future generations, protecting sources of clean water, providing protection for wildlife and habitat, emphasizing forest health, providing places that are natural in appearance, and protection of rare or endangered species.[13]

IMPACT OF NATURAL RESOURCES MANAGEMENT ON LOCAL COMMUNITIES

Residents of communities near public land are sensitive to land management choices. The region's communities are still in a lower economic status than surrounding state populations. Likewise, their economy is more dependent on natural resources. Of particular concern to residents of the area is the need to balance local interests to those interests of retirees, logging, and tourism.

The DBNF provides a core set of resources that can provide a variety of economic stimuli to the local communities. The significance of this potential is limited by the local community infrastructure. Roads, drinking water, sewage treatment, garbage disposal, health services, and retail outlets all have an impact on the ability of local communities to fully utilize the resources available on the Forest. As local area infrastructure improves (particularly the roads) the amount of growth increases. The utilization of the forest should correspondingly increase.

[13] Cordell, Ken; et al, 2002, Public Survey Report, Southern Appalachian National Forests, Daniel Boone National Forest, USDA Forest Service Southern Research Station, p. 9-10

VALUES AND ATTITUDES OF SOUTHERN APPALACHIAN RESIDENTS

Natural resource management attitudes and values that residents of the region hold are extremely important for land managers to realize. Research during the SAA analysis showed that most people believe environmental protection and economic growth can be compatible. However, when people had to choose between the two, their first choice was the environment. Most people think that environment protection has not gone far enough.

Furthermore, the SAA found that as retirees, urban transfers, and other new residents move into the SAA region, concerns for the health and aesthetic appearance of the region's ecosystems were likely to strengthen.

Residents living within and adjacent to the DBNF hold values similar to the SAA. The economy within the Forest area does not provide the expendable income available to those outside the area. The option to pay more for environmental protection is limited and therefore less acceptable. At the same time many in the local economy understand environmental functions and change. Most local residents work the land for a garden or pasture. The use of horses or mules can still be found throughout the region. Most counties still have at least one horseback riding club and one or more hunting clubs. They can also be fiercely protective of the land and its resources. Their perception of natural resilience and land abuse is based upon local experience.

The value, attitude, and beliefs survey of people with 75 miles of the DBNF found that people who reside in areas near the Forest put a high value on the protection of the Forest for the future. The management emphasis should be (in order of importance by survey respondents) passing along the Natural Forest for future generations, protecting sources of clean water, providing protection for wildlife and habitat, emphasizing the planting and management of trees for healthy forests, providing places that are natural in appearance, and protection of rare or endangered species.

The most popular recreation activities on the DBNF, according to the telephone respondents, were driving for pleasure (about 78 percent), picnicking (63 percent), viewing and photographing, wildlife, fish or scenery (60 percent), day hiking (41 percent).[14]

Environmental Effects

The DBNF activities have an effect on the local economy of 21 counties. An economic model called IMPLAN is used to examine how the Forest influences employment and labor income in the area. Due to substitution effects from competing non-government sources, these jobs are characterized as being associated with local economic activity initiated by Forest Service programs and activities, rather than caused by these activities.

Recreation and Forest Service expenditures are the programs most associated with jobs in the affected area; this relationship holds for all alternatives. Alternatives with a timber production emphasis contribute the third most to jobs of all Forest Service programs.

[14] *Ibid*., p. 14, 17, 66.

RESOURCE TABLE

The alternatives are a continuum ranging from more commodity production and provision for multiple-use to that of less commodity production and fewer resource uses, from continuing forest management to an emphasis on less forest management of forest resources as follows:

More Commodity Production			Less Commodity Production		
A	E-1	D	C-1	C	B-1

The Following two tables will be referred to in the economic effects analysis for each alternative.

Table 3 - 108. Forest Service Revenues and Payments to Counties (in millions of 2000 $'s).

Forest Service Program	ALT. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Recreation	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Wildlife and Fish	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Grazing	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Timber	$2.9	$0.4	$1.5	$1.5	$1.5	$3.2
Minerals	$1.4	$1.4	$4.4	$4.4	$4.4	$4.4
Soil, Water & Air	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Protection	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Revenues	$4.4	$1.9	$6.0	$6.0	$6.0	$7.7
Payment to States/Counties	$1.1	$0.5	$1.5	$1.5	$1.5	$1.9

Forest Service Revenues and Payments to Counties (Annual Avg, Decade 1; $1,000,000).

Table 3 - 109. Cumulative 50 year Present Values Costs and Benefits (thousands of 2000 $'s).

	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Cumulative Total Present Net Value	$2,778,559	$2,673,644	$2,822,831	$2,975,428	$3,145,513	$2,834,109
Present Value Benefits by Program						
Range	$0	$0	$0	$0	$0	$0
Timber	$68,682	$8,564	$37,888	$39,596	$37,531	$53,008
Minerals	$130,571	$106,787	$130,608	$136,741	$139,042	$145,892
Recreation	$1,170,165	$1,111,656	$1,170,165	$1,228,673	$1,287,181	$1,170,165
Wildlife	$1,993,241	$1,893,579	$1,993,241	$2,092,903	$2,192,565	$1,993,241
PV of Benefits	$3,362,658	$3,120,585	$3,331,902	$3,497,912	$3,656,319	$3,362,305
Present Value Costs by Program*						
Range	$0	$0	$0	$0	$0	$0
Timber	$60,359	$11,813	$42,811	$43,888	$41,790	$43,654
Roads/Engineering	$67,407	$85,770	$67,407	$67,407	$73,509	$73,509
Minerals	$21,037	$12,261	$18,362	$18,362	$12,863	$36,784
Recreation	$217,626	$202,222	$202,222	$214,425	$222,403	$208,323
Wildlife	$56,188	$12,261	$36,784	$36,784	$30,624	$30,624
Soil, Water, Air	$21,037	$24,522	$24,522	$24,522	$24,522	$18,362
Protection/Forest Health	$35,084	$12,261	$24,522	$24,522	$12,863	$18,362
Lands	$28,094	$18,362	$24,522	$24,522	$24,522	$30,624
Planning, Inv., Monitoring	$77,224	$67,407	$67,407	$67,407	$67,407	$67,407
PV Costs	$584,056	$446,881	$508,561	$521,841	$510,504	$527,649

*Costs are direct costs and Values are direct monetary returns from the program. All programs provide services that do not generate a monetary return e.g. timber program is modified to provide benefits for wildlife and plants that do not generate a direct monetary return. Recreation fees cover only a portion of the total recreational opportunities provided.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Economic assistance is available to eligible local communities, including federally recognized Native American tribes, through the Rural Community Assistance Grants program. Typically, the funding varies each year according to congressional allocation, but they are not dependent on factors specific to any alternative. Under all alternatives, the Forest would continue to fund, as available, natural resource-based projects to diversify, stabilize, and enhance local economies.

CUMULATIVE EFFECTS

Economic Impacts:

Cumulative effects analysis is designed to reveal the context of each alternative's impact within the planning area. This is done by comparing total changes in the planning area that would result from each alternative to total changes that would result from no action. Such a comparison is done by estimating employment and income at the expected end of the forest planning horizon (15 years) and calculating each alternative's share of the total economy. Estimates for employment and income growth were derived by calculating the average annual increase in employment and the real average annual income growth for counties in the analysis area from 1969 to 2000. The analysis is made with employment and income estimates for each alternative remaining at 2000 levels.

Our analysis assumes that the same rate of growth will continue over the 15-year life of the Forest Plan. The source of the data for these estimates is the U.S. Bureau of Economic Analysis.

Table 3 - 110 shows employment and labor income for the planning area. The first two columns present the 2000 base year and that portion of the base year attributable to use and management of the DBNF. The next column shows state and local government projections for 2015. Outputs for the various Forest Plan alternatives are assumed to be constant over the planning horizon. Included in the projections are employment and income effects attributed to the current direction (or no action), represented by Alternative A. The remaining columns show the separate effects of each alternative at the end 2015.

Table 3 - 110. Cumulative Economic Impacts in 2015

	2000		2015						
	Area	Forest	Area	Forest Portion					
Economic Indicator	Totals	Portion	Totals	Alt. A - NA	Alt. B1	Alt. C	Alt. C1	Alt. D	Alt. E1
Employment									
Total (jobs)	164,873	2,132	245,870	2,132	1,875	2,047	2,129	2,207	2,147
% of Area Totals	100%	1.3%	100%	0.86%	0.76%	0.83%	0.86%	0.89%	0.87%
% Change from No Action	---	---	---	0.0%	-12.1%	-4.0%	-0.2%	3.5%	0.7%
Labor Income									
Total ($ million)	$54,349.0	$45.3	$81,770.0	$45.3	$38.4	$43.4	$44.9	$46.2	$45.5
% of Base	100%	0.1%	100%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%
% Change from No Action	---	---	---	0.0%	-15.1%	-4.2%	-0.8%	2.1%	0.4%

What in 2000 accounted for 1.3 percent of all employment will in 2015 account for about 0.9 percent for the no action alternative. For the alternatives in the EIS, expected shares of the economy will range from 0.8 percent of the economy for alternative B-1 and C to 0.9 percent for alternative C-1, D and E-1. The selected alternative C-1 shows a .09 percent share of the local economy in 2015.

Employment changes in 2015 from the no action alternative range from –12.1 percent for alternative B-1 to 3.5 percent for alternative D. The selected alternative C-1 shows a –0.2 percent change.

What in 2000 accounted for 0.1 percent of all income will in 2015 account for about 0.1 percent for the no action alternative. For the alternatives in the EIS, expected shares of the economy will range from 0.0 percent of the economy for alternative B-1 to 0.1 percent for the remaining alternatives. The selected alternative C-1 shows a 0.1 percent share of the local economy in 2015.

Income changes in 2015 from the no action alternative range from –15.1 percent for alternative B-1 to 2.1 percent for alternative D. The preferred alternative C-1 shows a –0.8 percent change.

The cumulative effects analysis shows that over time employment and income proportionate share of the economy will decline for all alternatives except E-1. The Alternative E-1 would be the largest contributor to the economy.

Only 0.8 to 0.9 percent of the jobs, and 0.0 to 0.1 percent of the labor income is generated by DBNF activities. The Differences in total jobs between Alternative A (no action) and the other alternatives range from a decrease of 12.1% for Alternative B-1 to an increase of 3.5% change for Alternative D. The Differences in Labor Income between Alternative A (no action) and the other alternatives range from a decrease of 15.1% for Alternative B-1 to an increase of 2.1% change for Alternative D. Differences between alternatives may have noticeable effects within specific sectors of the local economy but will have little or no effect to the overall economy of the area or economy immediately outside the area. Differences in the alternatives are not likely to influence economic stimuli to the area from outside the area.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Social Impacts: Alternative A would emphasize recreation and timber production. Recreation is important but timber production is not as important to the survey respondents. According to the survey, the management emphasis of the DBNF should be (in order of importance by survey respondents) passing along Forest resources for future generations, protecting sources of clean water, providing protection for wildlife and habitat, emphasizing the planting and management of trees for healthy forests, providing places that are natural in appearance, and protection of rare or endangered species. This alternative would address all of these needs but place a greater emphasis on products from the Forest, which was not as important to respondents.

Economic Impacts: The jobs and labor income in the local economy resulting from Forest Service programs and activities are displayed in Table 3 - 111. The DBNF recreation program along with general Forest Service expenditures support the most jobs in the economy. There are 2,132 current jobs and $45.3 million in labor income associated with current Forest Service programs.

Table 3 - 111 Alternative A - Employment and Labor Income by Program.

Resource	Employment*	Labor Income **
Recreation	1,439	$25.9
Wildlife and Fish	175	$3.5
Grazing	0	$0.0
Timber	166	$3.7
Minerals	48	$2.1
Payments to States/Counties	15	$0.4
Forest Service Expenditures	289	$9.7
Total Forest Management	2,132	$45.3
Percent Change from Current	---	---%

* Employment by program by alternative (Average Annual, Decade 1).
** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Employment and income associated with National Forest activities are shown by major economic sectors of the local economy in the table below. The DBNF is associated with one percent of the local economy's total jobs and 0.9 percent of its labor income. Retail trade, services, and government are the economic sectors showing the most benefit from the Forest Service activities. After retail trade, services, and government, manufacturing is economic sector most affected by present DBNF management activity.

Table 3 - 112 Current roles of Forest Service-related contributions to the area economy (Alternative A).

	Employment (jobs)		Labor Income (million 2000 $'s)	
Industry	Area Totals	FS-Related	Area Totals	FS-Related
Agriculture	15,721	60	$138.8	$0.9
Mining	4,965	44	$274.7	$1.8
Construction	12,843	26	$330.1	$0.8
Manufacturing	32,140	174	$1,013.7	$4.4
Transportation, Communication, & Utilities	9,456	55	$346.8	$2.2
Wholesale trade	6,925	77	$212.7	$2.7
Retail trade	37,085	751	$561.4	$11.5
Finance, Insurance, & Real Estate	7,140	37	$166.8	$1.0
Services	44,393	658	$1,077.3	$10.9
Government (Federal, State, & Local)	30,329	240	$892.2	$9.0
Miscellaneous	2,115	9	$15.0	$0.1
Total	203,112	2,132	$5,029.5	$45.3
Percent of Total	100.0%	1.0%	100.0%	0.9%

The current revenue payment to the state and counties is $1.1 million Table 3 - 108.

Present value benefits, present value cost, and cumulative decadal present net values are shown in Table 3 - 109. The cumulative total present net value of Alternative A is $2,779 million. Wildlife ($1,993 million), recreation ($1,170 million), and minerals ($130 million) provide the greatest present value benefits. Recreation ($218 million), roads/engineering ($67 million), and planning, inventory, monitoring ($77 million) have the greatest present value costs.

CUMULATIVE EFFECTS

No cumulative effects beyond those already described above.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Social Impacts: Alternative B-1 would emphasize protection of the Forest while retaining the existing amount of recreation. Passing along natural forests for future generations, protecting sources of clean water, providing protection for wildlife and habitat, and providing places that are natural in appearance are addressed but emphasizing the planting and management of trees for healthy forests is not addressed. Recreation would remain at the existing level.

Economic Impacts: The jobs and labor income associated with local economic activity initiated by Forest Service programs and activities are displayed in the table below. This alternative would decrease in employment from activity generated by the DBNF by about 12.1 percent. Forest Service programs under Alternative B-1 would support 1,875 jobs, contrasted with 2,132 jobs estimated for the current plan. Recreation and Forest Service expenditures are the programs most associated with jobs in the economy.

Labor income of $45.3 million is associated with the current Forest service programs. Alternative B-1 should generate $38.6 million of labor income, a 15.1 percent decrease from the current level.

Table 3 - 113 Alternative B-1 employment, labor income by program.

Resource	Employment*	Labor Income **
Recreation	1,367	$24.6
Wildlife and Fish	164	$3.3
Grazing	0	$0.0
Timber	20	$0.5
Minerals	48	$2.1
Payments to States/Counties	2	$0.1
Forest Service Expenditures	273	$8.0
Total Forest Management	1,875	$38.6
Percent Change from Current	-12.1%	-15.1%

* Employment by program by alternative (Average Annual, Decade 1).
** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Employment and Income associated with National Forest activities are shown by major economic sectors of the local economy in the table below. Of the jobs associated with Alternative B-1, Manufacturing, services and retail trade jobs would be most affected.

Table 3 - 114. Alternative B-1 – employment, labor income by major industry.

	Employment*		Labor Income**	
Industry	Current	Alt. B-1	Current	Alt. B-1
Agriculture	60	56	$0.9	$0.9
Mining	44	43	$1.8	$1.8
Construction	26	21	$0.8	$0.6
Manufacturing	174	77	$4.4	$2.4
Transportation, Communication, & Utilities	55	46	$2.2	$1.8
Wholesale trade	77	66	$2.7	$2.3
Retail trade	751	696	$11.5	$10.6
Finance, Insurance, & Real Estate	37	32	$1.0	$0.9
Services	658	600	$10.9	$9.7
Government (Federal, State, & Local)	240	229	$9.0	$7.3
Miscellaneous	9	8	$0.1	$0.1
Total Forest Management	2,132	1,875	$45.3	$38.4
Percent Change from Current	---	-12.1%	---	-15.1%

* Employment by program by alternative (Average Annual, Decade 1).
** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Alternative B-1 would provide for $0.5 million revenue payments to the state and counties (Table 3 - 108). Current direction (Alternative A) provides $1.1 million in revenue payments to the State and counties.

Recreation plays a significant part in the DBNF's contribution to the local economy. Under Alternative B-1, the alternative with the lowest level of commodity production, recreation would produce 72 percent of the expected jobs contributed by this alternative and 64 percent of labor income.

Present value benefits, present value cost, and cumulative decadal present net values are found on Table 3 - 109. The cumulative total present net value of Alternative B-1 is $2,674 million. Wildlife ($1,894 million), recreation ($1,112 million), and minerals ($107 million) provide the greatest present value benefits. Recreation ($202 million), roads/engineering ($86 million), and planning, inventory, monitoring ($67 million) have the greatest present value costs.

CUMULATIVE EFFECTS

No cumulative effects beyond those already described above.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

Social Impacts: Alternative C would nurture natural forests for the benefit of future generations. Sources of clean water would be protected along with wildlife and its habitat. The emphasis on planting and cultivating trees would contribute to healthy forests, providing places of natural appearance while protecting rare or endangered species. It would maintain recreational opportunities at the existing level with no expansion.

Economic Impacts: The jobs and labor income associated with local economic activity initiated by Forest Service programs and activities are displayed in Table 3 - 115. This alternative would see a 4 percent decrease in employment from the present level of DBNF associated economic activity. Forest Service programs under Alternative C would create 2,047 jobs, contrasted with 2,132 jobs estimated for the current plan. Recreation and Forest Service expenditures are the programs associated with the most jobs in the economy.

Labor income of $45.3 million is associated with current Forest Service programs. $43.4 million of labor income would be associated with Alternative C, a 4.2 percent decrease from the current level.

Table 3 - 115 Alternative C – employment, labor income by program.

Resource	Employment*	Labor Income **
Recreation	1,439	$25.9
Wildlife and Fish	175	$3.5
Grazing	0	$0.0
Timber	87	$1.9
Minerals	48	$2.1
Payments to States/Counties	8	$0.2
Forest Service Expenditures	290	$9.7
Total Forest Management	2,047	$43.4
Percent Change from Current	-4.0%	-4.2%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Employment and income associated with National Forest activities are shown by major economic sectors of the local economy in Table 3 - 116. In addition to government, services, and retail trade, Alternative C impacts manufacturing more than other major sectors.

Table 3 - 116. Alternative C – employment, labor income by major industry.

Industry	Employment*		Labor Income**	
	Current	Alt. C	Current	Alt. C
Agriculture	60	59	$0.9	$0.9
Mining	44	44	$1.8	$1.8
Construction	26	24	$0.8	$0.7
Manufacturing	174	124	$4.4	$3.4
Transportation, Communication, & Utilities	55	52	$2.2	$2.0
Wholesale trade	77	73	$2.7	$2.5
Retail trade	751	744	$11.5	$11.4
Finance, Insurance, and Real Estate	37	36	$1.0	$1.0
Services	658	647	$10.9	$10.6
Government (Federal, State, & Local)	240	236	$9.0	$8.8
Miscellaneous	9	9	$0.1	$0.1
Total Forest Management	2,132	2,047	$45.3	$43.4
Percent Change from Current	---	-4.0%	---	-4.2%

* Employment by program by alternative (Average Annual, Decade 1).
** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Alternative C would provide for $1.5 million revenue payments to the state and counties as shown in Table 3 - 108. Current direction (Alternative A) provides $1.1 million in revenue payments to the State and counties.

Present value benefits, present value cost and cumulative decadal present net values are found on Table 3 - 109. The cumulative total present net value of Alternative C is $2,823 million. Wildlife ($1,993 million), recreation ($1,170 million), and minerals ($131 million), provide the greatest present value benefits. Recreation ($202 million), roads/engineering ($67 million), and planning, inventory, monitoring ($67 million) have the greatest present value costs.

CUMULATIVE EFFECTS

No cumulative effects beyond those already described above.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

Social Impacts: Alternative C-1 with its Goal of providing for ecosystem diversity with an added emphasis on recreation would serve to meet the most desired recreation activities of driving for pleasure and wildlife viewing as well as other recreation activities of importance to survey participants. According to the survey, the management emphasis of National Forests should be (in order of importance by survey respondents) passing along natural forests for future generations, protecting sources of clean water, providing protection for wildlife and habitat, emphasizing the planting and management of trees for healthy forests, providing places that are natural in appearance, and protection of rare or endangered species. This alternative would place the most emphasis on these interests.

Economic Impacts: The jobs and labor income associated with local economic activity initiated by Forest Service programs and activities are displayed in the table below. This alternative would have a 0.2 percent decrease in employment from the present level of DBNF associated economic activity. Forest Service programs under Alternative C-1 would create 2,129 jobs, contrasted with 2,132 jobs estimated for the current plan. Recreation and Forest Service expenditures are the programs most associated with jobs in the economy.

Labor income of $45.3 million is associated with current Forest Service programs. $44.9 million of labor income would be associated with Alternative C-1, a 0.8 percent decrease from the current level.

Table 3 - 117 Alternative C-1 - employment and labor income by program.

Resource	Employment*	Labor Income **
Recreation	1,511	$27.2
Wildlife and Fish	182	$3.6
Grazing	0	$0.0
Timber	88	$2.0
Minerals	48	$2.1
Payments to States/Counties	8	$0.2
Forest Service Expenditures	292	$9.9
Total Forest Management	2,129	$44.9
Percent Change from Current	-0.2%	-0.8%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Employment and income associated with DBNF activities are shown by major economic sectors of the local economy in the table below. In addition to services and retail trade, Alternative C-1 impacts manufacturing more than other major sectors.

Table 3 - 118 Alternative C-1 - employment, labor income by major industry.

	Employment*		Labor Income**	
Industry	Current	Alt. C	Industry	Current
Agriculture	60	62	$0.9	$1.0
Mining	44	45	$1.8	$1.9
Construction	26	25	$0.8	$0.7
Manufacturing	174	127	$4.4	$3.5
Transportation, Communication, & Utilities	55	54	$2.2	$2.1
Wholesale trade	77	76	$2.7	$2.7
Retail trade	751	778	$11.5	$11.9
Finance, Insurance, & Real Estate	37	37	$1.0	$1.0
Services	658	676	$10.9	$11.1
Government (Federal, State, & Local)	240	238	$9.0	$9.0
Miscellaneous	9	9	$0.1	$0.1
Total Forest Management	2,132	2,129	$45.3	$44.9
Percent Change from Current	---	-0.2%	---	-0.8%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Alternative C-1 would $1.5 million in revenue payments to the state and counties (Table 3 - 108). Alternative A would provide $1.1 million in revenue payments to the state and counties.

Present value benefits, present value cost and cumulative decadal present net values are shown in Table 3 - 109. The cumulative total present net value of Alternative C-1 is $2,975 million. Wildlife ($2,093 million), recreation ($1,229 million), and minerals ($137 million), would provide the greatest present value benefits. Recreation ($214 million), roads/engineering ($67 million), and planning, inventory, monitoring ($67 million) would have the greatest present value costs.

CUMULATIVE EFFECTS

No cumulative effects beyond those already described above.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

Social Impacts: Alternative D with is primary emphasis on recreational opportunities, would provide for the anticipated increase in demand for recreation with less emphasis on providing forest habitat diversity. Passing along natural forests for future generations, protecting sources of clean water, providing protection for wildlife and habitat, emphasizing the planting and management of trees for healthy forests, providing places that are natural in appearance, and protection of rare or endangered species are all addressed as important concerns in this alternative but the primary emphasis is recreation.

Economic Impacts: The jobs and labor income associated with local economic activity initiated by Forest Service programs and activities are displayed in the table below. This alternative would have a 3.5 percent increase in employment from the present level of DBNF associated economic activity. Forest Service programs under Alternative D would create 2,207 jobs, contrasted with 2,132 jobs estimated for the current plan. Recreation and Forest Service expenditures are the programs most associated with jobs in the economy.

Labor income of $45.3 million is associated with current Forest Service programs. $46.2 million of labor income would be associated with Alternative D, 2.1 percent above the current level.

Table 3 - 119 Alternative D - employment, labor income by program.

Resource	Employment*	Labor Income **
Recreation	1,583	$28.5
Wildlife and Fish	190	$3.8
Grazing	0	$0.0
Timber	86	$1.9
Minerals	48	$2.1
Payments to States/Counties	8	$0.2
Forest Service Expenditures	291	$9.7
Total Forest Management	2,207	$46.2
Percent Change from Current	3.5%	2.1%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Employment and income associated with National Forest activities are shown by major economic sectors of the local economy in Table 3 - 120. In addition to services, and retail trade, Alternative D impacts manufacturing more than other major sectors.

Table 3 - 120 Alternative D - employment, labor income by major industry.

	Employment*		Labor Income**	
Industry	Current	Alt. D	Current	Alt. D
Agriculture	60	65	$0.9	$1.0
Mining	44	46	$1.8	$1.9
Construction	26	26	$0.8	$0.8
Manufacturing	174	129	$4.4	$3.6
Transportation, Communication, & Utilities	55	56	$2.2	$2.2
Wholesale trade	77	80	$2.7	$2.8
Retail trade	751	812	$11.5	$12.4
Finance, Insurance, & Real Estate	37	38	$1.0	$1.0
Services	658	704	$10.9	$11.5
Government (Federal, State, & Local)	240	240	$9.0	$9.0
Miscellaneous	9	10	$0.1	$0.1
Total Forest Management	2,132	2,207	$45.3	$46.2
Percent Change from Current	---	3.5%	---	2.1%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Alternative D would provide for $1.5 million revenue payments to the state and counties (Table 3 - 108). Current direction (Alternative A) provides $1.1 million in revenue payments to the State and counties.

Present value benefits, present value cost, and cumulative decadal present net values are shown in Table 3 - 109. The cumulative total present net value of Alternative D is $3,145 million. Wildlife ($2,193 million) recreation ($1,287 million), and minerals ($139 million) would provide the greatest present value benefits. Recreation ($222 million), roads/engineering ($73 million), and planning, inventory, monitoring ($67 million) would have the greatest present value costs.

CUMULATIVE EFFECTS

No cumulative effects beyond those already described above.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Social Impacts: Alternative E-1 would emphasize recreation and timber production. Recreation is important but timber production is not as important to the survey respondents. According to the survey, the management emphasis of National Forests should be (in order of importance by survey respondents) passing along natural forests for future generations, protecting sources of clean water, providing protection for wildlife and habitat, emphasizing the planting and management of trees for healthy forests, providing places that are natural in appearance, and protection of rare or endangered species. This alternative would address all of these needs while placing a greater emphasis on products from the Forest, which was not as important to respondents.

Economic Impacts: The jobs and labor income associated with local economic activity initiated by Forest Service programs and activities are displayed in Table 3 - 121. This alternative would have a 0.7 percent increase in employment from DBNF associated economic activity. Forest Service programs under Alternative E-1 would create 2,147 jobs, contrasted with 2,132 jobs estimated for the current plan. Recreation and Forest Service expenditures are the programs most associated with jobs in the economy.

Labor income of $45.3 million is associated with current Forest Service programs. $45.5 million of labor income would be associated with Alternative E-1, 0.4 percent increase above the current level.

Table 3 - 121 Alternative E-1 - employment and labor income by program.

Resource	Employment*	Labor Income **
Recreation	1,439	$25.9
Wildlife and Fish	175	$3.5
Grazing	0	$0.0
Timber	180	$4.0
Minerals	48	$2.1
Payments to States/Counties	16	$0.5
Forest Service Expenditures	289	$9.5
Total Forest Management	2,147	$45.5
Percent Change from Current	0.7%	0.4%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Employment and income associated with DBNF activities are shown by major economic sectors of the local economy in Table 3 - 122. Alternative E-1 would impact manufacturing more than other major sectors.

Table 3 - 122. Alternative E-1- employment, labor income by major industry.

	Employment*		Labor Income**	
Industry	Current	Alt. E-1	Current	Alt. E-1
Agriculture	60	60	$0.9	$0.9
Mining	44	44	$1.8	$1.8
Construction	26	27	$0.8	$0.8
Manufacturing	174	183	$4.4	$4.6
Transportation, Communication, & Utilities	55	55	$2.2	$2.2
Wholesale trade	77	77	$2.7	$2.7
Retail trade	751	752	$11.5	$11.5
Finance, Insurance, & Real Estate	37	38	$1.0	$1.0
Services	658	660	$10.9	$11.0
Government (Federal, State, & Local)	240	241	$9.0	$8.8
Miscellaneous	9	10	$0.1	$0.1
Total Forest Management	2,132	2,147	$45.3	$45.5
Percent Change from Current	---	0.7%	---	0.4%

* Employment by program by alternative (Average Annual, Decade 1).

** Labor income by program by alternative (Average Annual, Decade 1; $1,000,000); in millions of 2000 dollars

Alternative E-1 would provide $1.9 million in revenue payments to the state and counties (Table 3 - 108). Alternative A would provide $1.1 million in revenue payments to the state and counties.

Under Alternative E-1, jobs and income from recreation would represent 67 percent of total jobs and 57 percent of total income that the DBNF contributes to the local economy.

Present value benefits, present value cost and cumulative decadal present net values are found on Table 3 - 109. The cumulative total present net value of Alternative E-1 is $2,834 million. Wildlife ($1,993 million), recreation ($1,170 million), and minerals ($146 million) would provide the greatest present value benefits. Recreation ($208 million), roads/engineering ($73 million), and planning, inventory, monitoring ($67 million) would have the greatest present value costs.

CUMULATIVE EFFECTS

No cumulative effects beyond those already described above.

CIVIL RIGHTS AND ENVIRONMENTAL JUSTICE

The following analysis discloses the relationship of significant and adverse environmental effects to minority population, low-income populations, and Indian tribes. Management direction in each of the alternatives would not commit resources to site-specific activities. Consideration of the significance of environmental effects is more appropriate during site-specific consideration of proposals to implement the 2004 Plan.

The National Forest System lands are intermixed with private and other public lands and occurs within portions of 21 counties. McCreary County has highest percentage of NFS land, 51.5 percent, and Knox County has the fewest at 0.03 percent. The DBNF comprises 14.6 percent of the 21 counties with NFS lands within their boundaries.

Table 3 - 123. Counties containing National Forest System lands.

County	County Acres	DBNF Acres	%
Bath	181,945	19,300	10.6%
Clay	301,798	77,594	25.7%
Estill	163,686	5,598	3.4%
Harlan	300,125	803	0.3%
Jackson	221,931	58,375	26.3%
Knox	248,373	74	0.03%
Laurel	284,373	62,478	22.0%
Lee	135,460	8,587	6.3%
Leslie	259,160	52,194	20.1%
McCreary	275,901	142,122	51.5%
Menifee	131,991	46,622	35.3%
Morgan	245,965	12,948	5.3%
Owsley	126,997	16,280	12.8%
Perry	219,649	2,191	1.0%
Powell	115,375	15,528	13.5%
Pulaski	433,385	37,441	8.6%
Rockcastle	203,653	14,793	7.3%
Rowan	183,419	62,509	34.1%
Wayne	309,824	642	0.2%
Whitley	284,902	45,365	15.9%
Wolfe	142,766	16,458	11.5%
Forestwide	4,770,447	697,902	14.6%
Kentucky	25,861,846	697,902	2.7%

MINORITY POPULATIONS

The 21 DBNF counties comprise approximately 11 percent of the state's total population. Less than one percent of the population within the 21 counties is made up of the minority populations listed in Table 3 - 124, with the exception of African Americans, which is slightly more than one percent.

Table 3 - 124. Minority Populations for Counties containing a portion of DBNF, (2000 Census).

Counties	Total Population (2000)	African American	Asian	Hispanic or Latino	American Indian/ Alaska Native	Native Hawaiian/ Other Pacific Islander	Other
Bath	11,085	205	2	89	23	0	44
Clay	24,5656	1,178	29	333	51	4	56
Estill	15,307	17	5	81	36	0	9
Harlan	33,202	869	96	216	159	5	28
Jackson	13,495	7	2	72	26	1	6
Knox	31,795	262	53	180	80	6	25
Laurel	52,715	331	182	291	193	5	44
Lee	7,916	300	8	29	22	1	5
Leslie	12,401	9	15	77	11	2	6
McCreary	17,080	108	3	106	72	1	34
Menifee	6,556	90	2	73	8	1	9
Morgan	13,948	611	23	85	21	2	8
Owsley	4,858	5	2	35	3	1	1
Perry	29,390	482	143	154	15	4	12
Powell	13,237	82	7	88	16	0	9
Pulaski	56,217	604	208	454	123	9	97
Rockcastle	16,582	23	21	102	40	1	7
Rowan	22,094	345	197	235	46	3	83
Wayne	19,923	297	22	291	35	0	93
Whitley	7,065	17	2	36	6	2	4
Wolfe	35,865	123	71	249	81	5	31
Forestwide	445,287	5,965	1,093	3,276	1,067	53	611
Kentucky	4,041,769	295,994	29,744	59,939	8,616	1,460	22,623

Data obtained from the U.S. Census Bureau.

Table 3 - 125. Percentage Comparison of Minority Populations, Daniel Boone National Forest.

Area	Total Population (2000)	African American	Asian	Hispanic or Latino	American Indian/ Alaska Native	Native Hawaiian/ Other Pacific Islander	Other
% of Forestwide Population	NA	1.3%	0.2%	0.7%	0.2%	0.01%	0.1%
% of Kentucky Population	NA	7.3%	0.7%	1.5%	0.2%	0.04%	0.6%
Forestwide Totals / Kentucky Population	11.0%	2.0%	3.7%	5.5%	12.4%	3.6%	2.7%

Data obtained from the U.S. Census Bureau.

LOW-INCOME POPULATIONS

The area's median household income is approximately 35.7 percent below the state average. Rowan, Pulaski, Powell, Laurel, and Bath Counties, come closest to the state median income, but remains approximately 23 percent below the state median. These counties either have a solid industry base or are within a reasonable commuting distance to industry.

Table 3 - 126. Low-income populations for counties containing a portion of DBNF (1999 dollars).

Counties	Median Household income ($)	Median Family Income ($)	Median Earning Male Full-Time Year-Round ($)	Median Earning Female Full-Time Year-Round ($)
Bath	26,018	31,758	27,786	20,986
Clay	16,271	18,925	24,164	17,816
Estill	23,318	27,284	29,254	18,849
Harlan	18,665	23,536	29,148	19,288
Jackson	20,177	23,638	25,087	16,065
Knox	18,294	23,136	24,833	18,390
Laurel	27,015	31,318	27,965	19,757
Lee	18,544	24,918	25,930	19,038
Leslie	18,546	22,225	28,708	18,080
McCreary	19,348	22,261	20,823	15,575
Menifee	22,064	26,325	25,670	17,014
Morgan	21,869	26,135	23,966	18,463
Owsley	15,805	18,034	25,100	18,203
Perry	22,089	26,718	31,702	20,502
Powell	25,515	30,483	26,962	18,810
Pulaski	27,370	32,350	27,398	19,236
Rockcastle	23,475	30,278	26,770	18,388
Rowan	28,055	34,338	26,777	20,104
Wayne	20,863	24,869	24,021	18,102
Whitley	22,075	27,871	26,518	17,001
Wolfe	19,310	23,333	23,859	18,952
Forestwide	21,652	26,178	26,307	18,506
Kentucky	33,672	40,939	32,357	23,285

Source: Profiles from the 2000 Census of Population and Housing, U.S. Census Bureau.
Table produced by the Kentucky State Data Center 5/02

INDIAN TRIBES

There are no federally recognized tribes or tribal lands within the proclamation boundary of the Daniel Boone National Forest or in Kentucky. There are, however, historic tribal lands of the Cherokee, Shawnee, and Chickasaw Tribes in Kentucky.